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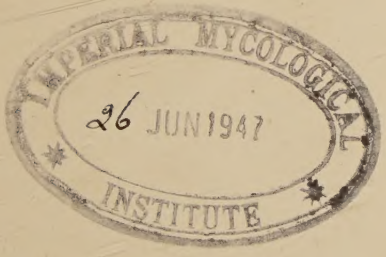

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[*Included by courtesy of the Queensland Government.*]

QUEENSLAND.

REGIONAL EXPERIMENTAL STATION, BILOELA.

PROGRESS REPORT FOR THE SEASON 1945-46.

BY

W. G. WELLS.

Introduction.

This progress report on the cotton investigations conducted at this Experiment Station during the 1945–46 season has been prepared from the reports submitted by the same officers as were responsible for carrying out the work in the previous season.

The past season started off under promising conditions, in that the main plantings were made in October—the best time to plant. Dry weather during the early stages of plant growth caused the development of a sturdy, tough plant structure with a deeply penetrating tap root—an ideal plant type for producing heavy yields, given favourable climatic conditions for the rest of the season. Unfortunately the rainfall was irregular during the critical fruit-forming period, and almost absent during the latter half of the season. Consequently only the lower and early middle crops matured in most of the rain-grown cotton experiments. In spite of the adverse season, some interesting results were obtained; these drew attention particularly to the need for ample subsoil moisture at planting time.

Table I. presents the more pertinent data for the season.

TABLE I.

Cropping Data.

Crop.	*Planting Dates.*	*Picking Dates.*	*Legal Close Season.*	*Rainfall* 30/6/45–30/6/46.	*Mean Temperature Oct. to May inclusive.*	*Mean Yield per Acre.*
Rain grown cotton ...	22–27/ 9/45 22–24/10/45	8/3/46 to 20/5/46	Nil	20.10 ins.	Max. 87·5°F. Min. 62·3°F.	140 lb. lint.
Irrigated cotton ...	13–30/10/45	8/3/46 to 20/5/46	Nil	+ 3 to 4 applications of 3 inches per acre.	Max. 87·5°F. Min. 62·3°F.	514 lb. lint.

Meteorology.

The total rainfall for the 12 months ending the 30th June, 1946, amounted to 20·10 inches, compared with the mean for 1924–46 of 27·69 inches. Table II. is presented to show the distribution of the rainfall during successive periods of the year which are important in the development of the crop—the June, 1945, rainfall being included

as past experiences have indicated that the June rainfall is normally of considerable importance to the following crop.

TABLE II.

RAINFALL (INCHES).

	June–September.	*October–December.*	*January–March.*	*April–May.*	*Crop Seasonal Total.*	*No. of Wet Days.*
1945–46	7·25	6·32	8·44	0·24	22·25	63
Mean 1924–46, inclusive	4·72	8·18	11·53	3·25	27·68	75

As the rainfall for the crop season was 5·43 inches below the mean and the preceding (1944–45) season was nearly 5 inches below normal, it can be seen that efficient penetration of the 1945–46 rainfall was required for satisfactory crop growth. Unfortunately 9·01 inches or 44·8% of the total rainfall for the 12 months ending 30th June, 1946, fell at an average rate of 2·02 inches per hour, compared with a mean of 1·43 inches for this "torrential" class of rainfall (over ·7 inches per hour) over the last eight seasons. Run-off was thus excessive especially in the critical month—January—when 4·6 inches out of a total of 6·99 inches fell at an average rate of 2·12 inches per hour. Temperatures as a whole compared favourably with the previous means except that the maxima from March onwards tended to be slightly higher while the minima tended to be lower, as would be expected during the prolonged dry weather experienced during this period. June 1946 was outstandingly cold at night, the mean being 10·7°F. below the previous mean—22 frosts with readings lower than 30·4°F. being recorded.

AGRICULTURAL PRACTICES.

Despite the unsatisfactory climatic conditions during mid and late season, some interesting results were obtained in the more important experiments conducted this past season. The following brief summaries present the main findings.

Time of Planting.—Once more the value of late-September and October plantings was demonstrated, the means from the different monthly plantings made over the Station being September—488 lb. seed cotton per acre ; October 473 ; December 134, and January 19.

Time of Ploughing Rhodes Grass.—Although the dry autumn tended to negative the benefits usually obtained from late-February or March ploughing of Rhodes grass preparatory to planting cotton in the following season, gains in favour of the earliest ploughing were once more obtained in a comparison of the merits of February, June and August ploughings—the mean yields being respectively 273, 223 and 244 lb. lint cotton per acre.

Residual Effect of Time of Ploughing Rhodes Grass Experiment on Cotton.—The area assigned to the time-of-ploughing Rhodes Grass Experiment reported upon in the Progress Report of 1944–45, was

again planted to cotton to test the residual effect of the different times of ploughing. The plots originally ploughed in August outyielded the other two times of ploughing (March and June). Soil moisture determinations failed to show any differences in the moisture content of the three times of ploughing to a depth of 30 inches. Nitrate readings at mid-December, however, indicated a higher nitrate content in the 0–6 inch level in the March and June ploughings than in the August ploughing. This finding is in keeping with results obtained in previous experiments.

The residual effect of March and June ploughings in the 1943–44 season of Sudan grass and in Rhodes grass established for 2, 3 and 4 years was also tested. No significant differences were obtained—the yields all being low—but the trends were in favour of the later ploughing. Nitrate determinations in December indicated that the March ploughed areas had significantly more nitrates than the June ploughed, and also that the greater the period of establishment of Rhodes grass prior to ploughing for cotton, the smaller was the amount of nitrates available. The results of the two experiments indicate that it may be advisable to plant a crop which uses large amounts of nitrates, such as grain sorghum, in the second year after February ploughings prior to planting cotton in the third year. This idea is being tested in the 1946–47 season.

Rhodes Grass—Cotton Rotation.—The value of planting cotton after grassland was again demonstrated—cotton in the first and second year after Rhodes grass yielding 240 and 226 lb. lint cotton per acre respectively compared with only 114 lb. for aged cultivation continuously under cotton. Cotton in the third year after Rhodes grass, however, yielded only 86 lb. lint cotton per acre. Although "third year" cotton generally yields less than either "first" or "second" year, it is most unusual for the differences to be so large or for the "third year" cotton to yield less than crops on land continuously under cotton.

Stubble Mulch Experiment (Rain-grown cotton).—Investigations were continued to determine the value of growing a winter wheat crop for hay and then preparing a seed bed for cotton in which as much as possible of the wheat stubble is left on the surface both to protect the soil from beating storms and to increase the permeability of the top soil. Under the dry conditions prevailing most of the season, no differences in yields were obtained between either disc ploughing, mould board ploughing, or stubble mulching done without the mould boards on the plough. It was noted, however, that the surface of the stubble mulched areas set much harder than the regularly ploughed areas—the stubble binding the soil into a "brick" like condition.

Soil Structure Studies.—Studies were continued on the soil structure, as measured by the relative percentages of water-stable aggregates larger than 0.7 mm., in areas under various cultural treatments. Once again the mean percentages by weight of the water-stable aggregates in the top six inches of soil were not significantly

different in rain-grown or irrigated areas repeatedly under cotton for 6 years. Work was also commenced to determine the percentage of water-stable aggregates in both virgin and cultivated areas of each major soil type in the district in a study of the deleterious effect of repeated cotton cultivation on the permeability of these soils.

Mechanical Harvesting of Cotton.—The investigations in mechanical harvesting of cotton indicated once again that cotton with a rank vegetative type of plant is not suitable for this form of harvesting. In tall, rank-grown cotton of the Miller and Rowden varieties yielding at the rate of 1,384 and 1,174 lb. seed cotton per acre respectively, the machine could harvest only 70% of the crop in either variety on the first run, but harvested up to 92% when the rows were re-run in the opposite direction.

Defoliation Experiments.—Overseas reports indicate that defoliation of a cotton crop prior to harvesting is advantageous for both mechanical and hand harvesting. Trials of spray mixtures of 4 lb. locally manufactured cyanamide with both 4 and 8 lb. of sodium fluosilicate to 50 gallons of water were tried. At mid-season on green, rapidly-growing plants, good leaf fall was obtained but prior to harvesting, when the leaves were tough and " leathery " as a result of the long dry period experienced in the second half of the season, little destruction of leaves was obtained with either spray. Trials will be continued in the coming crop with aero-defoliant—a preparation of this type now being commercially used in the United States of America.

Irrigation Investigations.

An additional well which was constructed prior to the start of the season, withstood a long pumping test at over 17,000 gallons per hour. This well is to be equipped with a 30 h.p. diesel engine and when used in conjunction with the tractor-powered old well, it will allow an increase in the area available for the study of irrigated crops and pastures. This development foreshadows the electrification of the adjacent districts and the supply of cheap power for individual pumps operating from wells and creeks.

The investigations in cotton irrigation consisted of the experiment testing the effects of supplementary irrigation (discussed in previous Annual Reports), a combined rotation and fertilizer experiment watered with spray irrigation, and a time and rate of spray irrigation experiment.

Effects of Supplementary Irrigation.—Although a rather good mean yield for the season experienced was obtained in the rain-grown plots of this experiment (284 lb. lint cotton per acre) the irrigated plots continued to maintain the relative superiority of approximately 350 lb. lint cotton per acre obtained in previous seasons—their mean yield this season being 664 lb. lint cotton per acre. This yield was

obtained with a 3-inch pre-planting irrigation early in October, a similar application at the end of December and a final 3-inch irrigation at mid-February plus 20 inches of rain for the crop year.

Combined Rotation and Fertilizer Experiment.—This exploratory experiment consisted of three rotations—continuous cotton, continuous cotton interrupted by a winter wheat crop to provide a stubble mulch for the 1945–46 cotton crop, and continuous cotton for several years, followed by 3 years of Rhodes grass prior to the 1945–46 cotton crop, a nitrogen *versus* no nitrogen comparison being superimposed on each rotation. Unfortunately a formal experimental design was not possible, but the results obtained with three irrigations totalling 9 inches indicated that the stubble-mulched plots were substantially inferior to either of the other two treatments between which there was no appreciable difference in the actual yields produced. No significant differences were obtained between 0 and 1 cwt. of nitrate of soda applied at planting although in each treatment there was a slight increase in yield on the 0 plots. The " bricking " effect observed in the dry farmed stubble-mulched experiment also occurred in the stubble-mulched plots of this experiment. Owing to the compacted surface, the final irrigation was applied by the flood-furrow system in order to get ample water into the soil—the previous spray irrigation running off after 2·5 acre inches had been applied.

Time and Rate of Spray Irrigation Experiment.—Previous experiments testing the effect of irrigation at various periods have indicated that when cotton is grown with rainfall supplemented by irrigation, incorrect timing of the application of irrigation can materially affect both the growth of the cotton plant and the resultant yields. This experiment combined several of the more important treatments of previous experiments and some modifications thereof, in a 6 × 3 randomised block layout. The results obtained indicated, as a whole, that under the dry seasonal conditions ruling, the treatment receiving the time-table of watering normally used in the experiments on the station was less satisfactory than the three treatments used in this experiment. One of these treatments, however, has consistently produced lower yields in past seasons when more rain fell in the first half of the growth of the crop. The remaining two treatments which emphasize early watering may lead to an improvement on the " normal" treatment, which in this experiment yielded 515 lb. lint cotton per acre. The experiment is being repeated in the 1946–47 season.

Soil Moisture and Nitrification Studies.

Soil moisture and nitrification studies were carried out extensively in the more important experiments conducted this season. Generally speaking, the results indicated that both factors followed the normal pattern for such a season as was experienced.

Soil moisture determinations indicated the value of the 3·5 inches of rainfall experienced in July in that at planting time most rain-grown

cotton areas were well moistened to a depth of 20–22 inches, although only a 2-inch planting rain occurred which, had a dry winter been experienced, would not have wetted the soil to a depth of over 12 inches. In the areas under winter wheat, the soil was wet to only 7–8 inches, thus indicating the need for very good planting rains for the cotton crop where stubble mulching with a winter cereal is practised.

The beneficial effect of a good growth of Rhodes grass in retarding run-off of heavy storms was well illustrated following a heavy beating 4-inch storm experienced in the last week in January when the surface soils were dry and set. This storm penetrated to a depth of 17 inches in grassland on a soil with a moisture equivalent of 38% as compared with only 6 inches in adjacent old cultivation continuously in cotton for several years, and 7 inches in an area in the first year of cotton after Rhodes grass. In another site where the moisture equivalent of the soil was 22–24%, the penetration was 19 inches in the Rhodes grass and 12 in the cotton land the first year after Rhodes grass.

In a comparison of land in its second year of cotton after three years of Rhodes grass and old continuous cotton land, the nitrate content of the former was mostly significantly lower from September onwards until the studies ceased at the end of January, the only exception being during a short period in December—the usual peak period of nitrification. Plant growth and yields on the old cultivation reflected the deleterious effect of the greater amount of nitrates present in the transitional period from the vegetative to the fruiting phases of the development of the plants.

No significant differences were obtained between the nitrate content of the soils in the time and rate of spray irrigation experiment where six methods of irrigation were used. In the effects of supplementary irrigation experiment, however, the usual outstanding difference in the general pattern of nitrification occurred—the irrigated plots having significantly less nitrate from the pre-planting watering to the end of the season. No significant differences in the nitrate content of the 0–6 inch level prevailed in any of the non-fertilized plots in the combined rotation and fertilizer irrigated experiment. However, a highly significant increase in nitrification was brought about by the application of 1 cwt. nitrate of soda in all three rotations, the readings in the plots on which cotton followed Rhodes grass tending to be substantially lower than the other two treatments, from the peak period of nitrification onwards.

Cotton Varieties.

A total area of 14·6 acres of cotton was devoted this season either to testing progeny row material or to trials of the various jassid-resistant strains developed by Mr. Marriott. Although the seasonal conditions severely affected results on some of the heavier soils, considerable

progress was achieved in several directions—the more important of which are briefly summarized as follows :—

Cotton Breeding.—Very satisfactory results were again obtained in the multiplication of the 43–9 strain of the Miller variety developed on account of its high lint percentage compared with the parent stock. A total of 1,000 lb. of seed is now available—the strain having produced at the rate of 1,000 lb. seed cotton or 380 lb. lint cotton per acre. A series of progeny rows of this strain again showed a significant positive correlation between the ginning percentages of the parent plants and their progeny rows, in spite of the fact that only plants with high lint percentages had been retained as parents. Lint characters were much more uniform throughout the whole plot of progenies and it would appear that a useful strain has been isolated. Its behaviour will be carefully tested in strain trials on the experiment station and district farms, however, for some evidence has been obtained in the past which appeared to indicate that varieties with high lint out-turn may fail to produce fibre of good strength under stress conditions.

The work of developing jassid-resistant strains by either selection out of Miller or by hybridization of Miller and other varieties with Ferguson, U.4 and a Rhodesian cotton was continued. Unfortunately no serious jassid attack occurred in the plot of 64 strains of Miller, but using the degree of hair cover on the leaves as an indicator, it appeared that satisfactory progress was being made in most strains in this respect. It was necessary to discard half of these Miller progenies because they were unable to produce a high ginning percentage under the extremely severe growing conditions. However two families III–17 and III–165 performed well, and gave promise of yielding strains with better lint length than the first releases of jassid-resistant Miller—strains lots 1 and 2. In view of Uganda results, an interesting sparsely fuzzed Miller selection—lot 1–19–2—was obtained which had a ginning percentage of 38. The multiplication of lot 1 was continued, some 3,400 lb. of pure seed being produced. In two varietal trials in a district where a jassid-resistant variety is desirable, this strain outyielded all other varieties in the trials on both fertile alluvial and decomposed granite slopes of low fertility, producing at the rate of 667 and 368 lb. lint cotton per acre respectively.

Further multiplication of the mass selected stock out of Miller 41S, touched upon in last season's Progress Reports, was effected on a co-operator's farm in the district, some 11,000 lb. of seed being obtained. This stock will be thoroughly tested in strain trials and commercial plantings during the coming season and if satisfactory results are again obtained with it as a whole, it will be used to replace the parent stock as rapidly as possible.

Of 8 Miller × U.4 hybrids which had been backcrossed to Miller for 4 generations, 2 had 100% of the population with dense or very dense long leaf hairs, while 2 more had over 95% of the population with the same type of leaf density. It has been shown, therefore, that

the transference of leaf hair cover from a hirsute to a non-hirsute variety is possible and that this hair cover can be retained by selection even after four generations of backcrossing to the non-hirsute parent. In addition these hydrids have boll weights and fibre types very close to the large bolled non-hirsute Miller parent. One series of second backcrosses has again yielded a group of sister progenies of marked uniformity for high leaf hair density, plant type and ginning percentage, which, if they perform satisfactorily in the yield trials in the coming season, should be of commercial value.

In the backcrossing programme between Lone Star, Mexico Acala and Triumph on the one hand, and Ferguson or a Rhodesian cotton on the other, which was late-planted under heavily irrigated conditions to provide favourable conditions for a jassid attack, the backcrosses exhibited the usual segregation of leaf hairs, but it was apparent that the Ferguson hybrids were in all cases more hirsute, later in maturity and more vegetative than the Rhodesian hybrids. These differences were apparent on the most casual observation. It was possible, however, to select plants combining a fairly open habit of growth, which is desirable in Queensland, with high leaf hair density and freedom of injury caused by jassids.

Entomology.

Seasonal conditions were far from favourable for the study of the corn ear worm, *Heliothis armigera* Hb. Plant growth was irregular in mid-season and dry weather later on lessened the probability of obtaining significant increases in yields from insecticidal treatments for the control of *Heliothis*.

The Time-of-Planting experiment designed to compare the activity of *Heliothis* in crops planted in October, early December and early January provided few data. Egg counts from all plantings were comparable at the recorded peaks but levels of infestation were low and square damage was negligible.

A 9 × 3 randomised block experiment was superimposed on a cultural trial in a rain-grown crop of cotton and aimed at comparing a 2% D.D.T. dust and an 0·5% ' Gammexane ' dust for the control of *Heliothis*. Applications were restricted to a single peak of egg laying. This peak was the only one in the season which exceeded the level normally considered likely to cause economic losses in the crop. Treatment effects were not apparent in the yields, but the percentage of sound squares a fortnight after the application of the dust was markedly higher in the D.D.T. plots than in either the ' Gammexane ' or control plots. Further, at the concentration used, the ' Gammexane ' dust had little or no effect on larval activity.

In irrigated cotton, a 5 × 4 randomised block experiment permitted a comparison between lead arsenate (90% dust applied twice at a four-day interval on each egg-laying peak), 2% D.D.T. and 0·5% ' Gammexane.' The last two dusts were applied once at each

peak. As in the rain-grown experiment, yield differences were not obtained but the data on square losses subsequent to the attack leave little doubt that a 2% D.D.T. dust is at least as efficient as, and probably more so than, a 90% lead arsenate dust for *Heliothis* control purposes. It must be emphasized, however, that at no time during the season was the pest sufficiently active to prejudice the growth of the crop. Larval populations on the plants after egg-laying peaks were consistently low.

EXPERIMENTAL PROGRAMME FOR THE SEASON 1946-47.

The proposed programme for 1946–47 embraces the following investigations.

Plant Breeding.—

(*a*) A continuation of the testing of the merits of the various generations of backcrosses of Miller and U.4.

(*b*) A continuation of the testing of the merits of the various strains selected from Miller for jassid-resistance, and the multiplication of Lot 1.

(*c*) A continuation of the testing of the Miller strain 43–9 and its progenies and multiplication of the parent stock of the strain.

(*d*) A continuation of the study of the inheritance of hybrids of Ferguson and a Rhodesian strain with New Mexico Acala, Lone Star and Triumph.

(*e*) Improving the uniformity of Miller 41S and New Mexico Acala strains now grown commercially.

Agronomic and Varietal Experiments.—A continuation of the general programme reported upon for the 1945–46 season with modifications in the experiments relating to both irrigated and non-irrigated cotton, to embody features arising out of this past season's work.

Entomology.—

(*a*) Age-of-land experiment to study further the egg-laying behaviour of *Heliothis* on land with different cultural histories.

(*b*) Insecticide experiment on rain-grown cotton to compare the efficiency of lead arsenate and D.D.T. dusts applied during peaks of *Heliothis* egg laying.

(*c*) Insecticide experiment on irrigated cotton to compare the insecticides lead arsenate and D.D.T. applied for the control of *Heliothis*: (*a*) at all egg-laying peaks during the growing period; and (b) at all peaks when the crop is flowering freely.

SOUTH AFRICA.

COTTON EXPERIMENT STATION, BARBERTON.

PROGRESS REPORT FOR THE SEASON 1945-46.

BY

D. MacDONALD, W. L. FIELDING AND H. E. KING

STAFF.

Mr. F. R. Parnell was away from the Station from August, 1945, when he sailed for England, until the end of March, 1946, when he returned from Uganda. Dr. R. C. Rainey resumed duty in January, 1946, on his return from military service.

INTRODUCTION.

The past season was the worst on record since work on this Station began, partly because of the badly distributed rainfall, but mainly on account of a devastating hail-storm accompanied by a wind of gale force on January 1st, 1946, which completely destroyed large areas of cotton breeding material and severely damaged other areas. Even in the less severely damaged material the stands were in many cases so reduced and the surviving plants so damaged that judgment and selection work in the field were rendered exceedingly difficult.

Where an ample reserve of seed was available in the form of special bulks, replanting was carried out, but a heavy attack of aphis on the replanted seedlings in January—February so retarded growth that when the plants recovered it was too late in the season for them to set and mature a crop. Fortunately a moderate reserve of seed of the strains which were completely destroyed is available for planting next season.

A tabular summary of the season's conditions is given in Table I.

TABLE I.

Planting Dates.	*Picking Dates.*	*Legal Close Season.*	*Rainfall.*	*Mean Temperatures.*
6th–11th December 7th January	End of May to end of July	Nil	Total for 12 months ending 30th June, 1946, 26·68 inches (Badly distributed).	1/11/45–30/4/46 Max. 84·8°F. Min. 63·4°F.

The main breeding work followed the lines of last season, dealing mainly with variety tests of, and selection within, hybrid material bred up previously. Investigations into hairiness and jassid resistance, in view of the conclusive results already obtained on the subject, were confined to a few points only on which further evidence was desired. One of the main points was the effect on hairiness of climatic conditions, locality and soil condition. Thanks to the co-operation of Messrs. Peat and Prentice it has been possible to compare the hairiness of

strain A.2106 when grown under varying conditions in Tanganyika and at Barberton.

A full report on the investigations into the relationship between hairiness and jassid resistance which have been carried out during a number of seasons is in process of being written up.

Apart from a heavy aphis attack in January—February insect damage was light. Stainers were again numerous from early in the season, but for the fourth consecutive season the incidence of internal boll disease was very low.

The acreage of cotton grown in the Barberton area was again very small, partly on account of the low price of lint compared with that of food crops, and partly on account of drought conditions which made the ploughing of dry land and consequent increase of acreage difficult. The season's crop was sold at 1/2 per lb. of lint, f.o.r. Barberton, an increase of over 25 per cent. on the previous season, and this increased price, coupled with the drop in vegetable prices due to the closing down of dehydrating plants which supplied convoys in war time, has resulted in a keen demand for seed for the coming season.

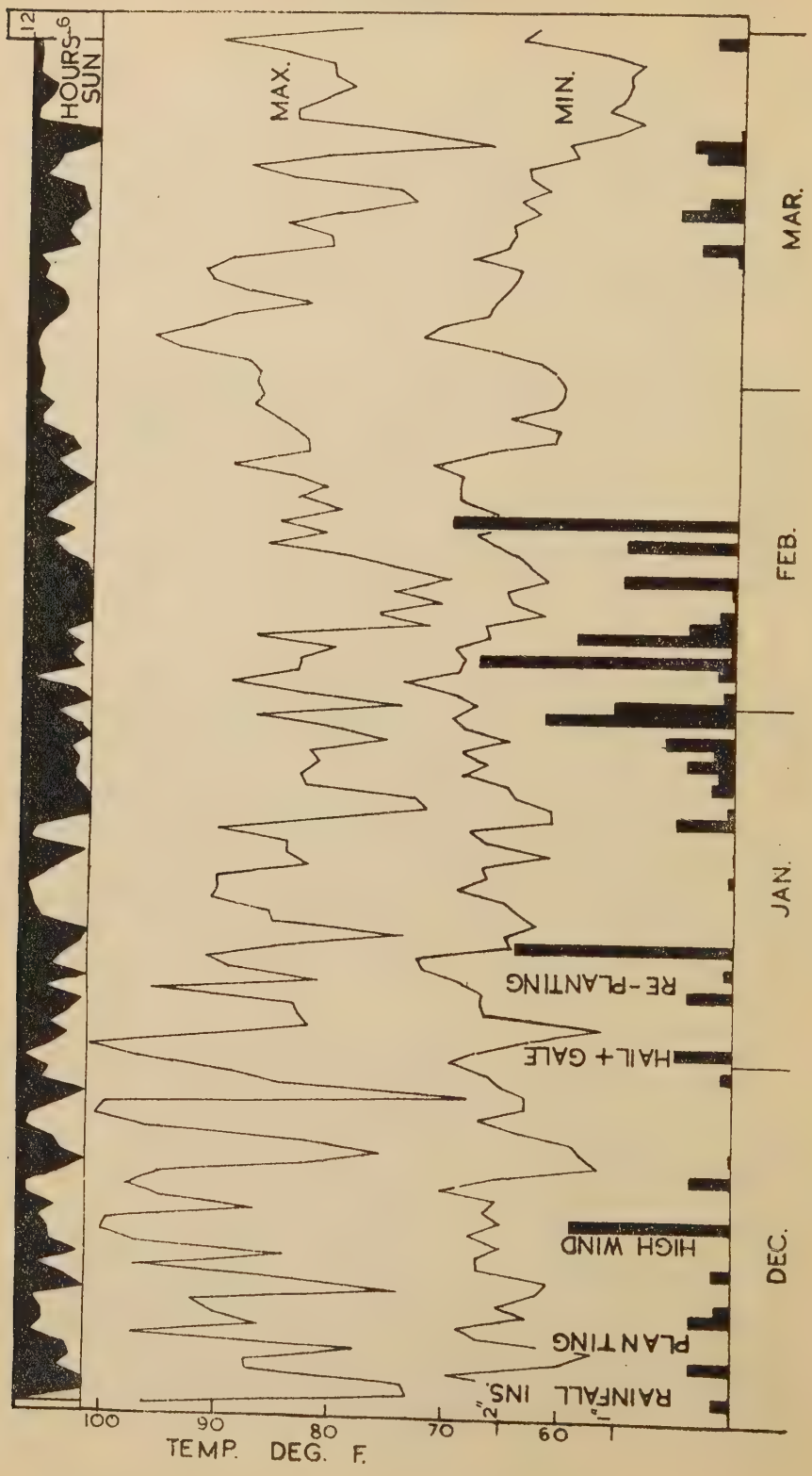
METEOROLOGY.

The total rainfall for the 12 months ending June, 1946, while amounting to 26·68 inches, was very badly distributed as 16·66 inches fell between January 1st and February 16th. Following the extemely dry season of 1944–45, when under 19 inches of rain were recorded, no effective rain fell between mid-March and mid-October, 1945. The October rainfall of light showers, totalling 1·92 inches, enabled ploughing to be completed, land already ploughed to be harrowed down and early germinated weeds to be destroyed, but loss through evaporation and cultural operations left no reserve in the soil. A small reserve of moisture was established in November, and the main cotton plantings were carried out following light showers with good surface conditions between December 6th and 11th.

Germination, considering the poor quality of seed derived from the previous drought season, though slow was good, especially so in the *hirsutum* crosses, and to a lesser extent in the Sea Island × U.4 group. On December 17th a very strong wind accompanied by 1·36 inches of rain in less than half an hour damaged and partially buried many seedlings. Recovery was slow, but finally good stands of weak seedlings were obtained throughout most of the breeding area, only to be lost to a greater or less extent by the hail and wind storm of January 1st.

During January 7·73 inches of rain fell, most of it (excluding the storm of January 1st) in an ideal gentle fashion, and the surviving early-planted cotton made a good recovery. Continuous rain, amounting to 8·93 inches during the first 16 days of February, coupled with lack of sunshine, favoured the development of a very heavy aphis attack which further retarded growth until better conditions prevailed during the latter part of February and March.

DIAGRAM I.—DAILY RAINFALL, MAXIMUM AND MINIMUM SCREEN TEMPERATURES AND DAILY SUNSHINE HOURS: C.E.S., BARBERTON, 1945–46



Growth and crop development during March and April were good, but with the fall in temperatures from the early part of May onwards not all of the bolls which set matured and opened their crop.

Diagram I, showing the daily rainfall, maximum and minimum temperatures and hours of sunshine from December to the end of March, when the rains ceased, illustrates the difficulties the crop had to contend with during the growing season.

GENETICS AND BREEDING.

Main Variety Trial.—A balanced incomplete block trial of 25 strains was planted in order to compare the yields of the 13 best U.4 × Cambodia strains with the 10 best U.4 × M.U.8 strains, as judged on previous seasons' results ; two standard U.4 strains including 5143, the strain in general cultivation, were also included in the trial. Hail damage reduced what had been good stands to a mean stand of 43 per cent. for the whole trial, while the mean stands for the different strains ranged from 28 to 56 per cent. Comparable yield figures for the 25 strains were thus unobtainable but field observations during the season showed that most of the crosses were superior in plant development and crop production to the standard U.4 strains.

As this was the first season in which many of our best M.U.8 × U.4 strains were included in the same trial as the best Cambodia × U.4 lots, it was of importance from the point of view of future selection work that a direct comparison between their hair characters and spinning value should be obtained. In previous tests on the Cambodia × U.4 strains none of the measured hair characters showed any consistent relation with yarn strength, the yarn strength being generally weaker than would have been expected from hair test results. On the other hand one of the M.U.8 × U.4 strains has already shown a low Standard Hair Weight coupled with a high maturity figure, and information as to whether later selections in this group show a similar character is important. Accordingly lint samples from the best 7 Cambodia × U.4 strains and the best 7 M.U.8 × U.4 lots as judged on previous seasons' results and field observation this season, together with samples of the two U.4 strains, have been forwarded to the Shirley Research Institute for spinning tests.

Seed Multiplication.—It was mentioned in last season's report that the Cambodia × U.4/5143 strain A.2106 would be issued to selected farmers for multiplication. For two consecutive seasons under widely different conditions this strain gave the highest yields in variety trials, far outyielding 5143, the strain at present in general cultivation. 150 lb. of seed of A.2106 was available for distribution and this was divided between six different farms for hand planting. Despite poor stands due to drought conditions in the early part of the season and further loss of crop due to flooding of lands in January—February, nearly 7 tons of seed are available for distribution during the coming season.

That so much seed is available is largely due to the successful efforts of Mr. S. N. Spear, Chairman of the Barberton Cotton Co-op. Society. With the 33 lb. of seed he received he hand planted 8 acres, and reaped 12,911 lb. of seed cotton, equivalent to a yield of 1,614 lb. per acre, which gave a ginning outturn of 33·79 per cent. at the commercial ginnery. Mr. Spear's success was not due to good conditions, as apart from rather better rains in the early part of the season, which enabled him to get a good stand established, and the absence of hail, his farm suffered badly from the excessive rains of January and early February, when over 19 inches of rain caused erosion and water-logging.

It is a striking tribute to A.2106 that under flood conditions, which normally result in the shedding of the greater part of the crop, it still held on to and matured an excellent crop.

A re-distribution of seed of this strain has again been carried out, seed being issued to selected farmers in the Swaziland and Magut areas as well as in the Barberton district. Unless anything unforeseen occurs sufficient seed of this strain ought to be available at the end of 1947 to supply the requirements of all cotton growers in the Low Veld of South Africa for the 1947–48 planting season, and completely replace 5143, the strain at present in general cultivation.

Hybridization.

*U.*4/5143 × *Cambodia and U.*4/8161 × *M.U.*8.—The single plants and special bulk plots of these lots were so badly damaged by hail that little progress could be made. Where possible special bulks were taken and they together with reserve seed will be planted during the coming season.

Quality Crosses.—The main objects of this series of crosses were given in the 1942-43 report and a description of the crosses was included in the 1944–45 report. Of the 7 acres planted with this material little survived the hail and while replanting was carried out on January 7th where seed was available, the replanted material was so badly damaged by aphis attack in the seedling stage that it never developed normally, thus rendering it useless for selection purposes.

*M.U.*8 × *Tidewater.*—Forty-one single plants and five special bulks of this cross were planted and while an ample reserve of seed of the special bulks exists, only very little seed of the single plants remains for replanting. Accordingly, in view of the promise exhibited by this cross in previous seasons, the cross has again been made and the F_1 will be grown during the coming season. While it is realised that in the time available before this Station closes down, the value of a fresh cross can not be exploited in full, it will be useful to have a reserve of F_1 seed which can be grown as an F_2 in future selection work at the New Research Station in Uganda.

5143 × *B.P.*52 *and M.U.*8 × *B.P.*52.—Much more uniformity was shown in the above two crosses by the surviving plants than in the

previous season. While, in the M.U.8 × B.P.52 material, it was possible to find plants with a good habit and hairs, it was very difficult to find this combined with lint approaching B.P.52 in quality. On the other hand, in the 5143 × B.P.52 plots there were many plants of U.4 habit combined with good fruiting and hairs, and at the same time possessing lint approaching in length and silkiness to the B.P.52 parent.

In back crosses of the 5143 group to B.P. 52 it was more difficult to find plants possessing good lint combined with the required standard of fruiting and hairs than in the straight cross. The reverse was the case in the M.U.8 back cross where plants could be found possessing much better lint than the straight cross without a corresponding drop in goodness of habit and hairs.

M.U.8 × Sea Island.—The two-acre block of this cross in the F_4 stage was so badly damaged that little could be done except to take special bulks of the best of the surviving plants in each progeny for replanting next season. So far as could be judged this cross has a higher limit of hairiness than the U.4 × Sea Island cross, but is inferior to it both in habit and fruiting as well as in lint length.

Sea Island, Egyptian and Tanguis × B.P.52.—As stated in the 1944–45 report these crosses had to be carried forward as special bulks as the season was too short for them to mature their crop. Of the three crosses now in F_3 only the Tanguis × B.P.52 was so badly damaged by hail that selection work was rendered impossible. Field observation in the remaining two lots showed that a difference existed between them similar to that which was noted in an earlier season between the corresponding U.4/8161 cross with Sea Island and Egyptian, viz., that in the Sea Island cross it was much easier to find plants with the combination of good habit, hairs, fruiting and lint than in the similar Egyptian cross.

B.P.52 when grown under our conditions tends to produce a tall leggy, and judged by U.4 standards, rather poor fruiting type of plant, and these B.P.52 characters appeared much more frequently in the Egyptian than the Sea Island cross.

Both crosses exhibited a wide range of leaf lamina hairs, but the Sea Island cross produced a much larger proportion of plants with leaf and stem hairs exceeding both in length and density the hairy B.P.52 parent than did the Egyptian cross. The same difference also appeared in lint characters, where not only length but also silkiness was definitely better in the Sea Island cross. Ginning per cent. differed little between the two crosses, the general tendency being for the longer linted plants to be lower ginners. 84 single plant selections, of which 63 are from the Sea Island × B.P.52 group, together with 3 special bulks, are being carried forward for planting next season.

While the majority of the single plant selections carried forward possess good leaf and stem hairs added to other good economic characters, a small proportion of plants with good leaf lamina hairs but with naked

or low-grade stems are also being planted. In the U.4 × Sea Island crosses progenies derived from plants with this hair combination generally tend to split for hair habit and fruiting and it will be useful to find out if a similar tendency to split exists in the progenies of naked stemmed plants in the B.P.52 × Sea Island group.

U.4/8161 × Sea Island and Egyptian.—542 economic single plant selections and 25 special bulks of these two crosses, now in F_6, were planted on a 16-acre block, about 80 per cent. of the selections being from the Sea Island cross. Half of this area was completely destroyed on January 1st, as it lay in the path taken by the centre of the storm, but on the other half the damage was less severe. Over the greater part of the remaining 8 acres the stand of plants that survived the storm was sufficient to enable differences both within and between families to be detected. As all the plots of the U.4/8161 × Egyptian progenies were completely destroyed the statements made in this section apply only to the U.4/8161 × Sea Island progenies.

The progenies remaining mixed for many characters were much fewer in number than in the preceding season. Examination of the ancestry of the lots splitting for hairs, habit, fruiting and lint again confirmed the statement made in the 1944–45 report that they were mainly the progeny of parent plants with good leaf hairs, but whose stems were either naked or possessed very few hairs.

Regarding the more uniform families, all of them are definitely more like the *G. hirsutum* than the *G. barbadense* parent in habit, fruiting and earliness, and as they stand many would be classed as a good looking commercial crop. Plant habit and fruiting is in many cases equal to and in some instances better than that of the U.4 parent while leaf hairs are consistently better in length and density.

Lint lengths are still variable between families but within progenies a fair uniformity exists. The actual range of lint lengths varies from 34 to 40 mm. but the bulk of the good lots lie within the 35 to 37 mm. range.

The fineness and silkiness of the lint in the good families, as judged by feel, is regularly far above U.4 standard, but while much of it is undoubtedly good, a true estimate of its quality must await hair character analysis and spinning test results. Ginning percentages vary very considerably between progenies and in some cases, though to a lesser extent, within progenies. Generally speaking, ginning outturn is below that of the U.4 parent, but in many progenies the pleasing combination of 35 per cent. ginning and 35 mm. lint was readily found.

Previous reports mentioned the tendency for early-maturing types to be associated with shorter and harsher lint than the standard aimed at, and that it remained to be seen whether this tendency could be effectively broken. The difficulties the plant had to contend with during this season were such that only an early-maturing type could set and mature a reasonable crop, and it is noteworthy that many of the

best families, *i.e.*, those with lint of 35 to 37 mm. allied to good fruiting and hairs, matured and opened a crop which appeared to be equal to and as early as the U.4 parent.

In order to get an accurate comparison of the yielding capacity of the U.4/8161 × Sea Island families with that of our best yielding *G. hirsutum* strains, a variety test consisting of five U.4/8161 × Sea Island types, together with 5143, A.2106, B.P.52 and a good yielding U.4/8161 × M.U.8 strain will be planted next season. This trial, in addition to providing yield comparisons, will also enable comparable lint samples to be taken and forwarded to the Shirley Research Institute for hair character analysis and spinning tests.

685 single plant selections and 69 special bulks are being carried forward for planting next season.

HAIRS AND JASSID RESISTANCE.

Experimental work on the relationship between hairiness of the cotton plant and resistance to jassid (*Empoasca facialis*) was this season reduced to a single demonstration plot containing a range of American Upland types of widely differing hairiness. Counts of jassid nymphs on the foliage of these types gave figures for comparative infestation entirely in accord with data from previous experiments, displaying a consistent relationship between degree of resistance and degree of hairiness of the leaf (see footnote).

Other field work on the Cotton Station, and on commercial crops in Barberton district, was directed to the problems of hair development throughout the growth of the plant, and the effect on hairiness of varying conditions of plant growth. By arrangement with Mr. J. E. Peat it was possible to extend this work to cover strain A.2106 grown on soil of high and low fertility at Ukiriguru in Tanganyika, leaf samples being collected there by Mr. A. N. Prentice and sent to Barberton for counts of hairs.

The study of this material has not yet been completed, but preliminary results support previous evidence that growing conditions markedly influence the length and density of the leaf hairs. At the same time it seems highly probable that, even under the very poorest growing conditions, an extremely hairy strain, such as A.2106, will still produce hairs of sufficient density and length to confer a high degree of resistance to attacks by *Empoasca facialis*, of the intensity met with at Barberton.

The difference reported last season (1944–45 annual report, page 22) between the rates of hair development in *G. hirsutum* and *G. barbadense* types, was again observed, using this season a Sea Island strain, in addition to X.1730. It seems probable that a slower rate of attainment of hairiness is a characteristic of the *barbadense* species.

A paper presenting the results of a number of seasons' work on this subject is in course of preparation and will be published separately.

Late-formed leaves high up the main stem (*e.g.* node 24) are quite appreciably hairy even in the Sea Island strain V.135, although this strain would be dismissed as non-hairy on inspection earlier in the season.

Records were made of the degree of leaf-hairiness shown by some of the most outstanding hybrid types in the breeding plots, in comparison with a number of standard strains, taking leaves at intervals thoughout the season. Data for one of these hybrid types A.5685, together with comparable figures for strain M.U.8, are given below for the lamina and midrib of the eighth and sixteenth main stem leaves (counting cotyledons as " O ").

It will be seen that breeding for improved hairiness (greater length combined with high density) has already achieved a most marked advance on M.U.8, the hairiest pre-existing *G. hirsutum* strain known at Barberton.

TABLE II.

Lamina and Midrib Hairiness of most hairy M.U.8 × Sea Island F_4 hybrid progeny, compared with the *G. hirsutum* parent M.U.8.

		Eighth Leaf.		*Sixteenth Leaf.*	
		A.5685	M.U.8	A.5685	M.U.8
LAMINA. (Lower surface)					
Total hairs per sq. cm.		311	110	881	464
Hairs per sq. cm. exceeding heights of ...	0·3 mm.	245	102	713	383
	0·5 mm.	162	81	498	278
	0·7 mm.	89	45	276	175
	1·0 mm.	22	9	65	34
MIDRIB.					
Hairs per 1 cm. length between petiole and nectary exceeding heights of	0·5 mm.	127	69	189	148
	1·0 mm.	74	34	94	57
	1·5 mm.	32	13	34	13
	2·0 mm.	9	1	5	0

A.5685 (hybrid progeny) figures are mean of 11 plants.
M.U.8 figures are mean of 6 typical plants.

Experiments.

Fineness-Maturity Relationship in Cotton Lint.—A further set of seed cotton and lint samples from a dated boll series was forwarded to the Shirley Institute in connection with the investigation on this subject being carried on there.

A uniform field of U.4/5143 was divided into 10 repetitions of 15-row plots and all flowers opening between 12th and 14th March were date tagged. Boll samples were collected from all plots at 5-day intervals, from 20 days to full maturity. It was found impossible to gin the 20- to 35-day-old boll samples and they have been forwarded as seed cotton. The remaining 10 sets of samples each yielded between 200 gms. and 400 gms. of lint in addition to 20 gms. of seed cotton. These 10 samples, in addition to providing material for investigation

of hair characters at different stages of lint development, are sufficiently large to enable small-scale spinning tests to be carried out.

Soil Structure and Grass Rests.—These two experiments, details of which have been given in previous reports, were continued. Soil samples from both experiments were again forwarded to Dr. W. S. Martin, of the Kawanda Agricultural Research Station, Uganda, who has very kindly undertaken to carry out examinations of the structure on annual samples from both experiments.

PROGRAMME OF WORK FOR 1946-47.

COTTON BREEDING.

Variety Trial I.—A repetition of the 1945–46 season's trial of 25 strains, which was destroyed by hail.

Variety Trial II.—Bulks of five U.4/8161 × Sea Island families together with B.P.52 will be tested for yield against our standard U.4/5143, the U.4/5143 × Cambodia strain, A.2106, and a high yielding U.4/8161 × M.U.8 strain. It is hoped to send lint samples of these strains for spinning tests in order to find out how the hair characters and spinning quality of the U.4/8161 × Sea Island families compare with B.P.52, and our standard *hirsutum* strains.

Hybridization.—Work will be continued on the material described in the present report.

Hairiness and Jassid Resistance.—Analysis of data from previous seasons will be continued and if time permits a full report of the work will be written up.

EXPERIMENTS.

Soil Structure and Grass Rests.—The experiment to test the effect of resting crops of Napier and Rhodes grasses on the red loam is being continued.

PLANT PATHOLOGY.

PROGRESS REPORT FOR THE SEASON 1945-46.

BY

G. M. WICKENS.

Verticillium wilt disease of cotton was first found at the Cotton Experiment Station, Barberton, in the season 1938-39, the occurrence being, as far as is determinable, limited to two plants only in one field. In 1939-40 a large number of affected plants was found in one area of the same field, but not elsewhere. On my return in July, 1945, it was learnt that in the intervening years the disease had made steady progress, becoming more severe in previously affected fields and spreading to new fields to an extent such as to make it desirable that some fields be put out of commission for cotton breeding work. It was decided that the study of this disease should receive priority.

It was therefore necessary to restrict the work on internal boll disease envisaged in an earlier report (Wickens, 1942), to a series of inoculation experiments with *Nematospora gossypii*. This line of work was chosen for two reasons. Firstly, it was anticipated that the results would provide a sound basis for assessing, in a stainer-damaged crop, the incidence of direct bug-feeding injury as well as of internal boll disease in relation to time of crop formation and development. Secondly, it was hoped that the experiments would lead to a sound and practicable method of determining relative susceptibility between cotton varieties that would be free from the objections to which methods used elsewhere are open. The objectives have in large measure been attained.

Verticillium Wilt Disease.

General observations.—This disease has appeared in three of the four blocks of fields into which the loam section of the station is divided, but (with the exception of one field specially selected in the area known to be the worst infested, in which the detailed studies described later were made) it appeared this season only in rather widely scattered single plants, with only one recorded example of an aggregation of affected plants in one small patch. This remarkably sparse and sporadic incidence has been, in two of these fields as well as in the more heavily infested field, accurately mapped, in order later to obtain information on the relation of incidence to infection foci in a previous crop.

Infected plants were found in plots of a number of strains from each of the following hybrids U.4/5143 × Cambodia, U.4/8161 × Sea Island, U.4/8161 × M.U.8. Numbers affected were far too small to indicate any possible variation in inherent susceptibility between or within these families.

The causal organism.—Many isolations of the causal organism, *Verticillium dahliae*,* have been made from naturally infected plants of season 1944-45 (from which cultures used in the inoculation experiments to be described were derived), and of season 1945-46. All isolations were of the same type; a sclerotia-forming *Verticillium* which sooner or later in culture produced pustules of a readily separable hyaline saltant. This saltant, which is characterised in culture by dense white aerial mycelium and complete lack of sclerotia or of dark-coloured mycelium, in striking contrast to the sparse aerial mycelium and dense black sclerotial development of the parent strain, has been shown in inoculation experiments to be only slightly pathogenic. The saltant has so far been found to occur naturally only in association with its sclerotial parent; it has not so far been isolated, free from the sclerotial type, from naturally diseased plants.

Observations on the effects of temperature on linear growth rate of the fungus in pure culture indicate a somewhat wide range as suitable for good growth, relative to the comparative absence of autostaling substances. The optimum under these conditions lies between 22 and 27·5° C. (72 and 81·5° F.), probably nearer the higher temperature, and the maximum is nearly 32°C. (89·6° F.). At the higher temperatures, growth soon becomes increasingly inhibited by the development of autostaling substances, so that for continued growth the optimum temperature becomes less, falling to 22°C. or lower. In the absence of knowledge of the role that products of the organism's metabolism may play in the causation of disease, observations on the influence of temperature on growth in pure culture are thus of doubtful value as a guide to the influence of temperature on the disease.

Pathogenicity and host range of V. dahliae.

The main results of inoculation experiments with *V. dahliae* and its hyaline saltant on cotton and other possible host plants are summarised below.

*Wound inoculation of cotton U.*4/5143 *in the field.*—On 22nd February, 1946, 74 days after planting, plants in the field were inoculated through stem wounds at the base, with sclerotial strains and hyaline saltants of the fungus. 56 out of 66, and 8 out of 37 plants respectively developed typical external symptoms of the disease. Sclerotial strains thus proved more able to induce disease, through wound inoculation, than hyaline saltants.

The incubation period in the majority of plants varied from 19 to 40 days.

Some of the inoculated plants were stripped of young bolls, flowers and flower buds at the time of inoculation, leading to delayed

*This designation is provisional. While there are many workers, with whom I am in accord, who prefer this designation for this sclerotia-forming fungus, there are those who consider that it should more properly be named *V. albo-atrum*.

fruiting and increased vegetative development. In the stripped plants, the incubation period tended to be shorter and the proportion of successful inoculations greater, as shown in the Table below.

PROPORTION OF SUCCESSFUL INOCULATIONS.

Days after inoculation.	*Sclerotial Strains.*		*Hyaline Saltants.*	
	Normal Plants.	*Stripped Plants.*	*Normal Plants.*	*Stripped Plants.*
26	7/37 (19%)	14/29 (48%)	1/19 (5%)	2/18 (11%)
41	26/37 (70%)	28/29 (96%)	2/19 (11%)	5/18 (28%)

In the rows of plants chosen for inoculation, only alternate plants were inoculated. All plants in the " inoculation rows " were separately picked, the yields recorded, and the seed saved for future examination of the possibility of seed transmission. Unfortunately, plant yields varied greatly with a low average owing to adverse climatic influences. For this reason it is not possible to have confidence in comparisons of the influence of infection on yield between sclerotial and hyaline strains and between stripped and unstripped plants. Over all, the mean reduction in yield as a result of infection was rather more than 50%.

Comparable control plants, similarly wounded but not inoculated, remained healthy and suffered no significant loss in yield.

The " inoculation rows " were separated one from another by four rows of untreated plants, as a guard against spread of disease from plant to plant. At the close of the experiment, on 2nd September, all plants in the " inoculation rows " and in their adjoining " guard rows " were cut off near ground level for examination for internal symptoms of disease. All plants that had shown external symptoms of the disease exhibited, on this examination, the typical internal discolouration of the vascular system. In the remaining plants, internal symptoms were shown only by three plants, all inoculated with sclerotial strains without having shown external symptoms. No evidence was found of any spread of disease from inoculated and diseased plants to neighbouring plants.

The course of disease in the inoculated plants was exactly similar to that commonly observed in naturally infected plants. From the first appearance of leaf symptoms all of the leaves showed symptoms in a very few days, shoot growth was restricted, many of the leaves and flower buds were shed and many of the younger bolls made little or no further development. After remaining in this condition for some time, often about 3-4 weeks, the plants normally made some further growth of very stunted but otherwise healthy appearance. But by 2nd September, almost all of the infected plants had been killed ; the stem tissues were dry and brittle, and there was no regrowth, in marked contrast to the uninfected plants in most of which the stem tissues were " sappy " and vigorous green regrowth was appearing.

Climatic conditions prevailing during this experiment were recorded for comparison with future experience.

Wound inoculation of cotton in greenhouse.—49-day-old plants of the Uganda strain BP.50 and of the U.4 × Cambodia cross, A.2106, growing in cans in the greenhouse were similarly inoculated with sclerotial and hyaline strains. All plants inoculated with sclerotial strains showed symptoms in 22 days, were severely diseased in all expanded leaves in 26 days, and by the 36th day were shrivelled and dead. No difference in reaction between the two cotton varieties could be seen. No apparent ill-effects resulted from inoculation with the hyaline saltant.

Soil inoculation of cotton in greenhouse.—In this somewhat elaborate experiment, of which only the main features are reported here, germinating seeds of the Uganda strain BP. 50 were planted at constant depth in cans (4 in. diam. × 4½ in. tall), each can holding 1kg. air dry soil, plus inoculum, with water added to bring soil moisture to 50% of water-holding capacity. By frequent weighing and addition of water as necessary, soil moisture was maintained at about 40-50%. The pH value of the soil was colorimetrically determined as 7.1. Proportions of infections obtained by various methods of inoculation were as follow :—

Method of inoculation.	*Strain of fungus.*	*Infection.*	%
40 gms. of 25% maize meal/sand inoculum per kg. dry soil, intimately mixed	Sclerotial.	11/11	100
3% maize meal/sand inoculum, added as above	,,	8/11	73
Richards solution/sand inoculum, added to soil as above	,,	2/7	29
10 ml. dense spore suspension per kg. of soil, intimately mixed	,,	0/8	0
Disc of agar culture placed immediately beneath germinating seed	,,	3/21	14
Do. Do. Do.	Hyaline	0/9	0

Clearly there are marked differences in effectiveness of the various methods of promoting soil infestation. The main value of these results lies at present in the indication of a satisfactory basic method of examining the influence of various soil factors on disease incidence by direct experimentation. Further, the results give promise of the evolution of a good method of determining relative susceptibility of strains and varieties of cotton, which may be of much value if attempts to secure uniform infestation in the field continue to meet with as little success as has been commonly reported hitherto.

The shortest incubation period of disease resulting from soil inoculation was 57 days, very much longer than that found to result from stem wound inoculation. The type of disease was similar to that occurring naturally in the earliest affected plants in the field, (described later).

Wound inoculation of other possible host plants in greenhouse.

Following are the main results obtained from stem wound inoculation, with sclerotial and hyaline strains, of various plants grown in cans in the greenhouse. The experiments were contemporaneous with those on wound inoculation of BP. 50 and A.2106 cotton described above, and all plants were of the same age.

The possible alternate host plants were chosen as having been reported elsewhere as susceptible, and as being crops more or less commonly grown in the local cotton-growing area.

Eggplant, var. Black Beauty, is fully susceptible to both strains of the fungus, though the effects of the hyaline strain are relatively very mild. The incubation period was shorter than in cotton, 17 days as compared with 22, but the ultimate effects less severe, the plants continuing to make fresh though very stunted and diseased growth long after the comparable cotton plants were dead.

Sunflower is susceptible to the sclerotial strain ; its reaction to the hyaline strain has not been determined. It is pertinent here to recollect the observations made by Bowmaker (1937) at Magut in Natal incriminating sunflower crops as responsible for causing increased infection in cotton.

Tomato var. Marglobe, is susceptible to the sclerotial strain only, the symptoms being very mild.

Sunnhemp was found to be partially susceptible to the sclerotial strain only, symptoms being rather similar to those induced by the *Fusarium* sp. causing widespread disease in the field. It should, however, be noted that the plants inoculated were poorly grown and out of season, and that wilt caused by *V. dahliae* has not so far been found in the field. The evidence is therefore insufficient to implicate this crop as a means of increasing infestation by *V. dahliae*.

Chillies were found to be apparently immune to both strains.

Field observations.

Detailed periodic observations were made in 88 rows, each of 77 hills, of U.4/5143 planted late (2nd January), at the south end of a field in the area regarded as wilt-infested.

By the end of May, 421 plants of a total stand of 5,299 had shown external symptoms of wilt, and three months later when the plants were removed a total of 633 had become infected to the extent of showing at least the characteristic internal symptoms at the base of the stem.

The field was adjacent to that in which wilt was first recorded in two plants in 1938-39 and in a number of plants in 1939-40. In the latter season it carried a poorly grown crop of U.4/5143, in which no wilt was actually recorded. Since then the field has been planted to five successive crops of maize with no cotton until the season under review. The extent of infection in the 1945-46 crop is thus remarkable ; almost certainly it was greater than in 1939-40, in spite of five years' continuous maize intervening.

The crop, after a promising start, suffered severely from a spell of dull wet weather and from aphis attack. Later it showed considerable improvement, but this renewed promise of a fair crop was

not fulfilled, falling temperatures, aided by a rather heavy stainer infestation, causing poor development of all but the earliest part of the crop. The final yield was only 180 lb. seed cotton per acre, from an 82% stand.

Wilt disease was first recorded on 20th March, 77 days after planting, in six plants. From this time until the end of May, weekly observations were made to record the number of plants newly affected, the nature and progress of symptoms in affected plants, and their exact position in the field. Some records were also made of plant heights and of numbers of bolls carried by diseased plants, as compared with nearest apparently healthy plants.

Three pickings were made, two in July and one at the end of August. At each of these, the 421 plants showing wilt symptoms before the end of May were separately picked and their yields at each picking recorded. The total area, less four rows at the north end containing no infected plants, was divided into 49 plots each of 12 rows of 11 hills, and these plots, after the wilted plants had been picked, were picked separately. Stand also was mapped.

At the close of the experiment at the end of August, the plants were cut off at the base, and vascular tissues of the stem examined for internal symptoms of the disease. The positions of affected plants were mapped.

The progressive incidence of wilt in relation to crop development and to climatic conditions was recorded diagramatically. This remains for the present purely a factual record ; no obligate relationship between incidence of disease on the one hand and crop development or environmental conditions on the other can legitimately be inferred from these observations on one crop and in one season.

The occurrence of two types of symptoms is noteworthy. The earliest-affected plants developed a striking pattern of rather sharply delimited interveinal chlorosis followed by necrosis. In a very few plants all of the leaves were thus affected and were shed, the plants dying rapidly. More commonly, not all of the leaves were affected, the plants continued to make stunted growth with small but otherwise apparently healthy leaves, and only the few affected leaves were shed. While all of the later crop was suppressed, the earliest bolls were able to continue to develop and eventually yield fair seed cotton.

The above symptoms, which are similar to those developed in plants grown in artificially infested soil in small cans, were found in the field only in plants affected before 27th March. Thereafter, the symptom expression was more characteristic of a wilt disease ; all of the leaves became flaccid and diffusely chlorotic, and later withered and were shed. A feature of this type of disease was the extremely rapid development of the symptoms ; quite commonly progress from apparently healthy appearance to a condition of all leaves being flaccid and chlorotic occurred within 2-3 days. Usually some apparent

recovery was made from this type of disease also, in the form of renewed very stunted but otherwise apparently healthy growth. Such recovery was, however, always slight, and usually did not appear until 2-3 weeks or longer after the first onset of symptoms.

Isolations of the fungus from plants affected at the several stages, including both types of symptom expression, were all identical in appearance.

The distribution of earlier and later affected plants, in relation to fertility, suggests a more rapid onset of disease in the more fertile areas. Again the observation must be treated with reserve ; it is, however, in line with the recorded shorter incubation period in plants induced to make increased vegetative development, and also with experience elsewhere.

The mean yield of the earliest affected plants was reduced by rather more than 50%, the loss becoming progressively less as the plants were later affected, with no apparent loss in plants first showing symptoms at the end of May. This is probably a considerable underestimate of potential loss in more normal crops, on account both of the tendency of the disease to have been concentrated in the more fertile areas, and of the very poor development of the later part of the crop in unaffected plants.

More than half of the plants showing external symptoms were not adjacent to earlier affected plants, and fresh foci of infection, not ascribable to root contagion, were found commonly on all occasions. Spread by root contact was at most rather limited, and much of the apparent spread must be ascribed either to progressive reaction of plants to inoculum already present in the soil, or to mechanical dispersal of inoculum, e.g., by cultivation.

Seed transmission.—The evidence at present available, on which to attempt to judge the likelihood of the disease being transmitted through the seed, is puzzling. On the one hand, there is much circumstantial evidence, from many parts of the world, in favour of its occurrence. On the other hand, attempts to demonstrate this mode of transmission have given negative results. These negative results are, however, for a number of reasons, not entirely convincing, and further investigation seems necessary. With this in view, seed from the affected plants in this survey, of known wilt history, has been saved for future testing as a possible source of new infection.

Boll Diseases.

General observations.

Stainer infestation was fairly heavy and early in relation to crop development, and resulted in rather extensive puncturing of bolls, with some damage to the developing seed cotton. Internal boll disease (*Nematospora gossypii*) was, however, light, and escape of the crop from considerable damage by staining must again be attributed

to only a small proportion of the stainer population actually carrying *Nematospora*. The following figures, from a sample of 7-8 weeks old bolls from the early part of the crop, are illustrative :—

Total locks examined	196.
Locks punctured	147, of which 79 had proliferated punctures indicating puncturing at a relatively early age.
Locks with *Nematospora* infection ...	11, mostly slight.

Two other types of fungal attack on lint were found, but did little damage. One was a rather conspicuous carmine pink staining of the lint, caused apparently by a chromogenic *Alternaria* sp., possibly the same as that isolated from leaf lesions (see later). The other, clearly in one or two instances associated with bug punctures, was a grey staining and breakdown of lint, caused by a fungus not yet identified.

Bacterial boll rot *Bact.* (*Xanthomonas*) *malvacearum*, commonly associated with other bacteria, also caused but little damage in the crop as a whole. In striking contrast, incidence was heavy in samples of bolls developed from flowers opened on 13th March, over 30% of the bolls being affected when 65 days old. Most of the infection was *via* the boll wall at the base ; a few were infected *via* a channel through the tip of the boll by incomplete union of the carpels. It seems likely that the rainfall of 12th and 15th March, after almost a month of dry weather, may be held to account for this unusually high incidence.

Incomplete union of the carpels, which seems to be associated with the growth of a rudimentary carpel up the centre of the boll, has been observed to be more or less prevalent in U.4 cottons in all three seasons of the writer's observations. The defect is potentially dangerous in two ways, firstly by tending to leave a channel at the tip of the boll through which bacterial infection may rather readily occur, and secondly (as has also been observed on a number of occasions) by loss of the protection normally afforded by the septa against spread of infection from lock to lock—a protection which is complete in the case of internal boll disease, and effective to a varying degree in the case of other pathogens.

Inoculation experiments with N. gossypii.

Bolls of U.4/5143 of 7 age-groups, from about 1 week to 7 weeks old, have been inoculated in the field with *N. gossypii*. The experiment was so designed as to give not only information on variation of susceptibility according to age, but also to enable evaluation of any influence there might be of varying period of boll development in relation to the crop as a whole, and of climatic conditions during boll development.

Two methods of inoculation were used (*a*) injection of spore suspension by hypodermic syringe, adapted to deliver uniform dosages small enough (0·012 ml.) to avoid breakdown of developing seed cotton by the water alone, (*b*) presenting to the caged bolls, for a three-day period, single adult *Dysdercus nigrofasciatus*, made infective by the simple method described in an earlier report (Wickens, 1942).

Adequate controls, to (*a*) by using similar dosages of sterile water, and to (*b*) by caging stainers not made infective, were employed throughout. Needle inoculations were made into two locks only of each boll. The remaining untreated locks, and in the case of stainer inoculations bolls untreated in any way, provided additional controls, from which can be determined the effects of sterile water injection and of stainer feeding without *Nematospora* injection.

Except for a few bolls taken while still green to check efficiency of the techniques adopted, all were allowed to mature. All were protected against unwanted insect attack throughout development.

Symptoms produced by both methods of inoculation by *Nematospora* were identical and typical, except that rather more severe effects were produced by needle injection than by stainer injection in bolls of the same age. As expected, feeding activity varied considerably between individual stainers, leading to greater variability in severity of resultant disease in bolls of the same age than that induced by needle inoculation : needle inoculation gave extremely uniform results.

The effects of needle inoculation of *Nematospora* into bolls of varying ages are exemplified by the following :—

Boll age at inoculation. Days.	*Symptoms.*
16 – 17	The locks reduced to a small walnut-kernel-like mass, most of the lint being not recognisable as such, but matted down to a wrinkled film over the " seed " surfaces, mostly brown in colour from the point of inoculation outwards, then silvery in appearance. The very little recognisable lint shows typical yellow staining except at the tip of the boll, where it is white and normal in appearance although very short and weak. Carpel splitting and reflexion largely inhibited.
23 – 24	The locks much reduced in size, though not quite so severely as in the above. Lint on the exterior face almost all matted down and silvery in appearance, except at the tip where lint appears normal although short and weak. On interior faces the lint is matted down to a thin wrinkled brown film nearest the point of inoculation, then matted down and silvery or stained deep yellow-brown.

The main feature of the above early infections is the destruction of boll contents ; such cotton is not picked and represents a total loss. The effect is a rotting of both seed and lint, in contrast to later infections where there is little if any obvious rotting, but more or less extensive staining of the lint.

29 – 30
37 – 38
44 – 45
51 – 52

In the youngest of these, the locks are noticeably reduced in size. The exterior faces show a silvery appearance except at the tip of the lock, and " webbing," caused by adherence of lint hairs to the edges of the split carpels, is prominent. No staining is apparent on the exterior surface, except occasionally a small spot round the point of inoculation, sometimes extending a short way longitudinally along the suture line. In the interior of the lock, however, and especially on the inner faces, staining of the lint is intense, except at the tip of the boll.

All of these symptoms are progressively reduced in intensity and extent as the bolls are older at time of inoculation. In the oldest, no symptoms are apparent from the exterior ; on the interior faces staining is barely perceptible to slight, in a rather small area.

The effects of stainer-introduced *Nematospora* were similar, though a little less severe in bolls of a similar age.

Direct injury to young bolls, from stainer feeding without the introduction of *Nematospora*, was very variable, according to the amount of puncturing. In bolls on which single stainers were caged from 8–9 to 11–12 days old, injury varied from slight light brown to silvery matting of the lint in a small patch over one seed, the lock otherwise developing normally, to almost complete destruction with no seeds developed and only a trace of light brown or silvered lint detectable. The maximum effect was reduced with increasing age of boll at time of exposure to stainer, to a barely perceptible spot of discoloured lint at 30–31 to 33–34 days.

Needle inoculation of sterile water produced no apparent ill effects.

Steyaert (1939) described a standardised technique of boll inoculation, employed in determining relative " resistance " of strains of cotton to internal boll disease. This method has also recently been employed in Peru (Boza et al., 1945) and it seems desirable that attention should here be called to what are held to be serious shortcomings.

Rainey (in the press) has presented data which strongly indicate that cut bolls used for inoculation by this method are unlikely to remain for long in a normal physiological condition. He states further, " . . . It is furthermore doubtful, in view of the marked variation in both sugars and susceptibility with boll age, whether estimates of both on bolls of a single age provide sufficient material for adequate comparisons between varieties. Differences in physiological age between bolls of the same chronological age may well give appreciable differences in both sugars and susceptibility ; for example, the present material, at the same age as Steyaert's, required only three days' growth to give a fall in reducing sugars equal to the difference (0·62% fresh weight) between his highest and lowest varieties." There seems therefore room for doubt whether differences in apparent susceptibility indicated by this technique would necessarily be reflected in differences in degree of attack in the field.

Steyaert's method may possibly indicate a degree of potential escape from internal boll disease damage, greater in some varieties than in others owing to more rapid physiological development of the boll. (At present this seems more likely than that there might be varying degrees of real resistance to the fungus). But such potential escape might be negatived by a more protracted fruiting habit ; in other words, in seeking varieties with improved potentiality for escape from staining damage, both reaction of the bolls to inoculation by the fungus at varying ages, and rate of fruiting, need to be considered.

The writer's method of inoculation by syringe, of bolls developing normally on plants in the field, has given results exactly comparable with those resulting from stainer inoculation and with the disease as found occurring naturally, and has now reached a stage at which varietal differences can be investigated with some confidence.

One merit of Steyaert's method lies in the objective measurement of area of staining on the lock surface, a measurement which cannot be made with any accuracy, either in unsplit bolls or in the matured bolls, inoculated by the writer's method. Material from the inoculation experiments described above is in progress of examination to determine the influence of inoculation at varying ages on lock weight, seed weight and lint index. The work is not yet completed, but there is already promise that one or more of these objective measurements may similarly be accurately applicable as an index of susceptibility to staining.

Leaf and Stem Diseases.

Alternaria was common on senescent leaf. Two very distinct strains have been isolated from leaf spots of identical appearance, one a chromogenic shyly sporing strain, and one a non-chromogenic freely sporing strain. Cultures and diseased material have been sent to the Imperial Mycological Institute.

The damage caused by *Alternaria* leaf spot has not been assessed ; such assessment would indeed be a difficult matter. So far, the fungus has been observed to develop, to any but a negligible extent, only on senescent leaf. Whatever therefore may be the additional deleterious effect of the infection, the problem at present appears to lie in the retarding of leaf senescence.

Angular leaf spot and blackarm (*Xanthomonas malvacearum*) caused but little damage.

Diseases of Other Crops.

Fusarium wilt of sunnhemp was prevalent in two fields, causing appreciable damage. The causal organism has again been demonstrated, by inoculation of many plants in the field, to be non-pathogenic to cotton.

Death of a few trees in the *Cassia siamea* windbreaks has been investigated, and found to be due to a fungus provisionally identified as *Ganoderma* sp. Cultures and diseased material have been sent to the Imperial Mycological Instutite.

ACKNOWLEDGMENT.

I am indebted to the Imperial Mycological Institute for a first report on the identity of cultures of *Verticillium dahliae* from cotton.

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PROGRAMME OF WORK FOR 1946-47.

VERTICILLIUM WILT DISEASE.

(1) Studies on the relation between disease, crop development and environment will continue, and will include study of its incidence in relation to recorded incidence in the previous season.

(2) Inoculation experiments will be made, mainly with the objective of finding a method, practicable on a large scale, of obtaining uniform infection in the field.

(3) The relative susceptibility of a number of varieties of cotton to natural infestation will be determined.

(4) The possibility of seed transmission will be examined.

ANGULAR LEAF SPOT, BLACKARM AND BACTERIAL BOLL ROT.

(5) By controlled spraying of bacterial inoculum in the field, the susceptibility of the U.4 derivatives 5143, 8161 and 88 ; Cambodia ; M.U.8 ; and strains derived from the crosses U.4/5143 × Cambodia and U.4/8161 × M.U.8, to angular leaf spot will be determined. Standard strains from Dr. Knight in the Sudan, of known genotype for resistance, will be used for comparison.

It is hoped also to make preliminary observations of the relationships between angular leaf spot, blackarm and bacterial boll rot susceptibilities.

As judged necessary, resistant plants in strains showing heterogeneity for resistance will be selfed with the objective of separating purely resistant substrains.

INTERNAL BOLL DISEASE.

(6) By employment of the technique suggested in this report, the relative susceptibility of a number of strains, chosen as having as widely variable boll and lint characters as are available, will be determined. Parallel boll samples will be taken for future chemical analysis, should appreciable differences in reaction to *Nematospora* inoculation be found.

[*Included by courtesy of the Southern Rhodesia Government.*]

SOUTHERN RHODESIA.

SEASON 1945-46.

Introductory Note

BY

G. S. CAMERON.

***Chairman, Cotton** Research and Industry Board.*

What appeared to be a very promising season, at the start, turned out eventually to be most disappointing. In the past it has been considered, generally, that a good opening season was half the battle, as far as cotton in Southern Rhodesia is concerned. 1945–46 proved to be an exception, but it is not certain whether the season was to blame as much as attacks from Sudan bollworm in the early, bud stage of the plant's development. Cotton growers throughout the country were optimistic, and their early estimates indicated a yield per acre far in excess of what finally materialised. Plantings were restricted, partly due to lack of labour, but due also, in some measure, to the necessity of planting food crops. Although guaranteed prices were higher than ever before, these were largely offset by a further increase in prices guaranteed for maize, while prices realised for tobacco were such as to make cotton prices poor in comparison. Nevertheless the more progressive farmers realise the benefit of cotton in their rotation, a fact which they have proved to their own satisfaction, and which is borne out in the following report by Mr. McKinstry.

The total acreage planted was 4,041, of which 312 acres were abandoned, leaving 3,729 acres harvested. This gave a total yield of 347,954 lb. lint equal to 93·31 lb. lint per acre. The ginning percentage was 32·94.

Whether the introduction of grass leys is to prove beneficial under Southern Rhodesia conditions remains to be seen, but investigations have been initiated by the Department of Agriculture, and the Cotton Station at Gatooma is planning to carry out a certain amount of work in line with these more comprehensive investigations. The system of farming adopted on the Cotton Station, however, has proved to be sound over a period of years and under varying soil and climatic conditions. Taking maize yields as a criterion, there has been no deterioration of the soil ; on the contrary, maize yields have increased progressively ever since the land was first brought into cultivation.

The report confirms and emphasises the concern expressed, as far back as 1942–43, about the serious increase of damage to cotton caused by Sudan bollworm. The investigations into methods of destroying over-wintering pupæ will be followed with keen interest by cotton growers in the Colony, who are beginning to realise the necessity of maintaining a close season although, unfortunately, there are still too many who fail to recognise that such a measure is imperative if the depredations of Sudan bollworm are to be kept under control.

While there is good reason to believe that cotton-growing in Southern Rhodesia has been firmly established, the immediate prospect of increasing the acreage and the number of growers is not promising. Only an improvement of yield cum price will increase the proportion in relation to other more remunerative crops. An additional drawback, and one likely to continue for some years, is the shortage of Native labour required, especially at the time of harvesting the crop. This shortage of Native labour is not confined to cotton, but affects other crops and secondary industries also.

The introduction of cotton-picking machinery is under consideration and, should it prove successful, there is a possibility that existing growers would increase their cotton acreages to a considerable extent. There is also the possibility that cotton would be grown in districts now sparsely occupied, but better suited to cotton than to other crops.

COTTON RESEARCH STATION, GATOOMA.

PROGRESS REPORT FOR THE SEASON 1945-46.

BY

A. H. MCKINSTRY.

Planting period	Mid-November.
Flowering	End February to Early March.
Picking	May–June.
Date of Uprooting	30th September.

Part I.

Meteorology.

The total rainfall for the period 1st November to 30th April was 30·58 inches ; of this amount only 0·72 inches was recorded after 16th February. The start of the rainfall season was one of the earliest on record, good planting-rains having fallen in the second week of November. Thereafter, rains were sufficient and well distributed until about the end of December ; but during the greater part of January and, until rains ceased, for all practical purposes, about the middle of February, there was too much rain. During this latter period the lands remained very wet for several weeks. This condition hampered greatly the weeding and cultivating of crops, and also the taking of routine records on plant development and insect pests.

In parts of other cotton-growing districts planting rains tended to be later than around Gatooma, and rainfall distribution generally was more erratic in November and December.

In the previous season (1944–45) the total rainfall for the period 1st November to 30th April, was 24·31 inches, compared with the total of 30·58 inches in the past season (1945–46). The main difference between the two seasons attributable to the rainfall distribution is that crops in 1944-45 germinated erratically on very poorly distributed rains in December, whereas in 1945-46 an even germination took place about a month earlier, about mid-November, on well distributed rains. The two rainfall seasons were similar, however, in that the total period over which effective rains fell was little longer than three months.

In the past season, as in 1944–45, wintry weather conditions were prolonged, but the lowest minima temperatures recorded were on the average a few degrees higher than in 1944–45.

Agricultural System.

Rotational Value of Cotton.—The value of cotton as a rotation crop in increasing the yield of the following maize crop has been emphasised frequently in the reports from this Station. Further proof of this fact is given in Table 1 in which it is shown that maize following cotton has yielded about 3·5 bags grain per acre more than maize following sunnhemp, the most widely grown leguminous green manure crop. Similarly, maize following cotton was better than maize which followed leguminous hay crops by about 2·5 bags grain per acre.

TABLE I.

Maize grown in Rotation with other Crops. Yield of Maize in Bags of Grain per Acre.
(1 bag = 200 lb. grain.)

Year.	*Maize planted after Cotton.*		*Maize planted after Sunnhemp Green Manure.*		*Maize planted after Leguminous Hay Crops.*	
	Acres.	*Yield of Maize. Bags per Acre.*	*Acres.*	*Yield of Maize. Bags per Acre.*	*Acres.*	*Yield of Maize. Bags per Acre.*
1942–43	97·9	11·4	67·5	8·6	—	—
1943–44	26·8	24·5	63·3	16·6	11·5	17·8
1944–45	21·0	12·9	57·7	12·4	15·7	12·6
1945–46	27·5	17·7	42·8	14·4	15·5	12·0
Means	43·3	16·6	57·8	13·0	14·2	14·1

Although the yield figures given have not been derived from an actual rotation experiment, they are none-the-less of definite value, for they represent the yields of maize, grown in rotation with other main crops in a system of mixed farming, in a number of consecutive seasons recently.

Grass-Leys.—Cotton was planted in two large observation plots adjacent to each other. In one of them the cotton followed cotton, in the other it followed a five-year-old "Woolly Finger" grass-ley. Owing to heavy American bollworm damage in these plots yields were very poor. Although there was no difference in the yield of seed cotton per acre between the two treatments, both plant stands and growth generally were appreciably poorer in the cotton which followed

the " Woolly Finger " grass. The poorer stands were caused by a strong surface mat formed by the remains of the grass with the soil ; this mat hindered greatly the brairding of the young cotton seedlings, despite the fact that a heavy seed rate was used at planting. The poorer growth may possibly have been due to nitrogen starvation of the cotton caused by insufficiently decayed grass residues. The results indicate that in like experiments in future grassland should be ploughed towards the end of the previous rainy season, and not during the dry months as was the case in this experiment.

From observations in this experiment and elsewhere it would seem that the yield of cotton, grown in comparatively small plots situated adjacent to a larger acreage of maize, is likely to be greatly reduced by American bollworm attack which originates in the maize crop. (See American bollworm).

Grasses.—Ten varieties of grasses representing five different species were established in observation plots under rainfall conditions. These grasses were planted in mid-January from roots supplied by the Manager of the Salisbury Experiment Station. After planting, rainfall was plentiful for about a month, since when practically no rain has fallen to date (October, 1946).

Of these introductions those named below have given the best cover to the soil's surface and, in addition, have remained comparatively green and are now showing signs of new growth. This latter is a very desirable character, in view of the fact that indigenous local undeveloped grasslands are practically valueless as grazing during the hot months and until after the first rains fall. The most promising grasses are:—

1. Panicum Makarikari.
2. Mount Elgon Star grass.
3. Star grass No. 2.
4. Star grass No. 8.
5. Napier Fodder (Dwarf type).

Panicum Makarikari, grown in quite large acreages, has already given very good results over a number of years under rain-grown conditions on one farm in the district. But, apart from this example, there have been few attempts at pasture improvement locally, though much interest is now being shown by farmers in this important phase in the agricultural system.

At this Station the principal object of the work on grassland development is to investigate the place to be taken by cotton in systems of mixed farming which include rain-grown grass-leys of different kinds. To draw an analogy, in the same manner that compost-making was developed at this Station, because investigations proved that the cotton crop benefited from applications of compost, so, too, it is now considered advisable to investigate the possible uses of grass-leys with reference to cotton-growing.

Agricultural Practices.

Pre-Planting Preparation of Land.—There was no statistically significant difference in the yield of cotton grown on land which had been ploughed, rolled with a Cambridge roller, and disc harrowed, the usual practice, compared with the crop grown on land which was disc harrowed only ; but plots of this latter treatment yielded at the rate of 95 lb. seed cotton per acre less than plots which had been ploughed, rolled, and disced. The following observations made during the growth of the crop are also in favour of the ploughed, rolled, and disced treatment.

(*a*) Ploughing gave a rougher finish to the soil's surface, and this condition persisted well into the season. This would be an advantage in hindering soil erosion and in retaining rainfall on the land.

(*b*) There was appreciably less weed growth in the ploughed plots. This advantage was particularly noticeable in the very young stages of the cotton plant's growth.

(*c*) The plants in the ploughed plots were better for growth and development generally. This advantage was first observed about two weeks before flowering commenced.

Yields in the above experiment were poorer than those in adjacent cotton. This difference was probably due to the fact that compost was not applied to the plots of the experiment, whereas the remainder of the field received 5–7 tons compost per acre. It was noted also that *Alternaria* infection was more prevalent in the experiment. (See *Alternaria*).

Treatment of Cotton Seed.—Acid-delinted cotton seed treated before planting with (*a*) Agrosan and (*b*) Shirlan was compared with untreated acid-delinted seed in a number of trials. Comparisons of final yields and plant stands were made. There were no statistically significant differences between any of the treatments.

Topping of Cotton Plants.—This experiment, details of which were given in the 1944–45 report, was repeated in the past season. The main results obtained were firstly, that the yield of " topped " plants was a little poorer than that from the control or not " topped " plants, and secondly, that there was no apparent difference in the amount of staining in the seed cotton from either treatment.

Cotton Plant Development.

As indicated previously, the Station's cotton was planted in the second and third weeks in November, 1945. Weather conditions for germination could hardly have been bettered. This fact was reflected in the final plant stands which, taken over all lands, averaged 90% of a full stand. Climatic conditions generally remained very favourable to the young plants until early in January. Thus, the crop got away not only early but also to a very good start. However, for the greater

part of January and until rains ceased for all practical purposes in mid-February a too-abundant rainfall in conjunction with much cloudy weather made for very wet conditions in the lands. These latter factors not only resulted in appreciable water-logging of the soil, thereby delaying weeding and cultivation operations, but they also favoured the development of *Alternaria*.

Flowering commenced in mid-January and it was in its peak period during late February and early in March ; but a month later, in early April, it had declined markedly, and thereafter few flowers were produced.

The shedding of young squares, pre-flowering, and shedding of buds and young bolls during the important first six or seven weeks of flowering—until early in March—was quite pronounced, more so than during a similar period in the growth of the crop in 1944-45. This shedding loss in the early crop was caused very largely by bollworm damage, mainly due to Sudan bollworm attack, as also happened in 1944-45.

The total crop lost by shedding showed a marked increase early in March, and, thereafter, most of the buds and young bolls produced were shed. This was due principally to decreasing moisture and, also, to an increasing attack by the different bollworms.

The first bolls to mature fully were recorded at the end of March, and by the middle of May most of the crop had opened. It was taken in one picking, which was mainly done in June.

The mean yield of the Station's crop in 1945–46 was about 120 lb. lint per acre. This yield was obtained from all the different spacings, strain types, etc., factors normally connected with the work of this Station. The comparable figure in 1944–45 was 100 lb. lint per acre.

In both of the past seasons, as is usual, the crop picked has been made largely during the period covered by the first six to eight weeks of flowering.

Again in both seasons, the principal factor responsible for crop loss during the early flowering and also in the pre-flowering period has been Sudan bollworm. This loss was greater in 1945–46 than 1944–45.

Comparing the much greater plant stand of 90% obtained in 1945–46 with that of about 35% in 1944–45, it might be expected that the difference in the yield generally would be greater than 20lb. lint per acre in favour of the 1945–46 season. That this difference was not greater is probably due to the heavier damage done by Sudan bollworm and to a lesser extent to high rainfall conditions (which favoured *Alternaria* and caused quite marked water-logging of the soil) in the early pre-flowering and flowering stages in the crop.

Cotton Breeding.

Seven strain trials were planted; in three of these there were fifteen strains in an Incomplete Block (I. B.) arrangement consisting of balanced pairs; but in the remaining four trials there were only nine strains, drawn from among fifteen, in the more orthodox Randomised Blocks (R. B.) lay out. Further, the length of row in the R. B.'s was double that in the I. B.'s; in each case individual plots consisted of a single row.

In a statistical analysis of the seven trials individually, good significance was obtained in each of the three trials of the I. B. arrangement, whereas only two of the R. B. trials were statistically significant.

As the advantages, both in regard to significance, and also in number of strains compared per unit area of land, were in favour of Incomplete Blocks, this arrangement will be used in future

Of the three repetitions of the Incomplete Blocks trial, one was planted in each of the three fields under cotton. The severity of jassid attack varied from field to field, however, and where it was worst, the yield of a small number of strains which were comparatively poor for resistance was affected markedly. For this reason most reliance may be placed on the yields of strains in that repetition of the I. B. trial in which jassid damage was most severe.

The results of this trial given in Table II show that of the fifteen strains compared most of the derivatives of the (64/7/10 × Cambodia) × 64/7/10 crosses, or more briefly the 7Cs, gave the highest yields of lint per acre. Again, from the yield results, there does not appear to be much to chose between the highest yielding derivatives of either the 64/7/10 or those of the 64/V family group.

TABLE II.

Cotton Strains Trial.

Ancestry of Strains. Family Groups—More recent parent.	*Strains Number.*	*Yield Lint. per acre in lb.*
(64/7/10 × Cambodia) × 64/7/10 = 7C	12204	157
" " " "	12405	155
" " " "	12490	142
64/V 9L34	12438	137
64/7/10 7L5	12219	137
64/V 9L34	12437	131
64/V 64/V/NO 3	9L34	131
64/7/10 7L5	9L18	129
64/V 9L34	12348	124
64/7/10 7L5	12231	120
64/V 9L34	12447	120
64/V 9L34	12347	113
64/V 9L34	12270	111
64/7/10 7L5	1222	111
(64/7/10 × Cambodia) × 64/7/10 = 7C	12215	109
Difference required for significance	=	13

With regard to lint quality, as apart from yield, laboratory analyses have shown that members of the 7C family group have the shortest staple, whilst the best lengths and quality of staple are found in

9L34 and selections from it, all of these latter being in the 64/V group of strains. The remaining strains, all belonging to the 64/7/10 group, but all selected more recently from the strain 7L5, are mostly intermediate for length and quality of staple between the 7Cs and the 9L34s.

Further, a large-scale spinning test, made recently at the Gatooma mills on a representative of the 7C group and another strain selected from 9L34, has shown the 7C yarn to be rather weaker than that from the 9L34 selection ; but the former appeared to be more regular, and had a better finish.

Considering yields and the various other tests as a whole, therefore, the decision has been reached that there is not yet a suitable strain available to replace immediately 9L34 now in commercial cultivation.

From an examination of Progeny Rows, grown in the past season, current selection work is being directed mainly to an improvement of lint quality in the 7C derivatives, and to a greater uniformity for jassid resistance in the derivatives from 9L34 and 7L5. Such improvements will be considered in conjunction with yield of lint per acre in all cases.

None of the strains introduced in recent seasons from Barberton has given as good results, all characters considered, as the best of the Gatooma-bred strains.

A number of quality crosses, also obtained from Barberton, on a first growing have been disappointing, especially for jassid resistance. But as this material is very variable it merits a further search for desirable selections.

As circumstances permit next season, certain of the Gatooma strains will be crossed with a limited number of introduced varieties having better quality lint. A certain improvement in lint length and fineness, but not necessarily a great improvement, in combination with the present yield and jassid-resistance characters possessed by a number of the Gatooma strains would definitely enhance their value.

Cotton Pests.

Jassids.—Populations of this pest varied in numbers in different parts of the Station. In one field, where the attack may be described as moderate, there was little damage done, even to those strains with comparatively smaller amounts of leaf hair. But in two other fields where jassids were more numerous it was possible to discard with confidence those strains and selections which were poorer for resistance. The main period of jassid attack was during March, with a peak about mid-March.

American Bollworm.—Small numbers of larvæ were taken in cotton during the first few weeks of its flowering, but total populations of this pest remained low until early in March, in which month the main attack developed.

During the peak period total larval numbers were small. It is probable that the crop loss which they caused would have been accounted for by other adverse factors, the principal one of which, at the time, was diminishing moisture supplies. For the same reason in the 1944–45 season, much of the shedding due to American bollworm attack, although greater than in the past season, would have been lost. In both seasons rains ended about five to six weeks after the very first flowers in cotton had been produced.

Once again the maize crop, in "attractive" tassel, gave good protection to the cotton in its early flowering stages from American bollworm egg-laying moths. The maize, planted about the same time as the cotton, tasselled mainly during the last three weeks of January. Large numbers of American bollworm larvæ were taken in the maize in late January and in February, whereas during this period few were to be found in cotton which was then in its early flowering stages.

Both in the past season and in 1944–45, the main American bollworm attack in cotton commenced definitely to develop during the sixth week after the start of flowering.

American Bollworm: Maize-Cotton Relations.—In several Reports previous to the one for 1937–38, there are references to the fact that the American bollworm moth population in any given season is at first attracted to lay eggs in the large acreages of commercial maize; and furthermore, that it is after these crops have ceased to be attractive (i.e. in fresh tassel) that attack by this pest tends to become concentrated upon the smaller acreages of cotton then coming into full flower.

In the 1937–38 Report, however, negative results were obtained in preliminary investigations to determine whether the first bollworm eggs laid in the first maize crops could give rise to a flight of moths which lay their eggs in cotton later. But it was noted that though the intensity of this first egg laying on maize is low, it takes place over a large acreage and that, therefore, it might affect the egg-laying position in cotton.

During the War years further examination of these particular questions concerning American bollworm activity was not possible. But in the past two seasons, the records have shown that larval populations in cotton commenced definitely to increase in the sixth week after the very first flowers appeared in the crop.

In each of these seasons the maize and cotton crops were planted about the same time and, though conditions for germination differed in the two seasons, the comparable rates of brairding in the two crops were affected similarly in each season by existing weather conditions.

Relating these recent observations to facts known about, (*a*) the number of days taken from planting to the appearance of the very first tassels and flowers in maize and cotton respectively and (*b*) the close correlation which exists between tasselling in maize and egg

laying by the American bollworm moths, a case may be made in support of the theory that the generation of moths which originated the main American bollworm attack in cotton, in the two past seasons at least, was bred in the maize crop ; the cotton and maize having been planted about the same time. For example :—

Firstly, in maize (Hickory King variety) the number of days from planting to the start of tasselling (= start of American bollworm egg laying) is about 56 days.

Secondly, the total mean period from the time that American bollworm eggs are laid to the time that the moths emerge, in the summer months, is about 39 days.

Thus, in about (56 + 39) or 95 days from planting date the first moths bred in maize will be in flight.

Finally, subtracting from 95 days the number of days taken from planting to the start of flowering in cotton, or about 63 days, a remainder of 32 days is obtained.

Therefore, in the above example, American bollworm maize-bred moths could be available for egg laying in cotton in the fifth week after this crop starts to flower, provided that the cotton and maize have been planted about the same time. But as the time taken for egg maturation within the female moth is about two days, and as a further few days, (say 4–6 days) are necessary for newly hatched larvæ to grow sufficiently in order that fair numbers of them may be " spotted " easily by African recorders, it does seem probable that larval populations in cotton, which may be derived from maize-bred moths, will tend to show in the records a definite increase in numbers when the cotton is in its sixth week of flowering. These calculations are supported by the actual facts observed in the past two seasons.

While it is probable that the majority of moths which originate the main larval attack in cotton is bred on maize, it is also likely that a smaller number of moths contributing to the main attack might also be derived from the very early but light egg laying which takes place in the cotton itself in its early flowering stages.

In future, closer study will be made of the habits of American bollworm larvæ in maize, and also of possible means of reducing their numbers in this crop. In this connection certain of the newer insecticides will be tried. Also, records of the number of full grown larvæ per plant and of the amount of sheath cover at the tip of the cob will be examined for existing correlations. Should it be established that such correlations are largely negative in character, then attention will be given to the growth of strains of maize with a good enveloping sheath.

American Bollworm : Dolichos-Cotton Relations.—As a general observation it may be emphasised once again that American bollworm larval populations in cotton have been very much smaller in the past six seasons, 1940–41 to 1945–46, than in the six seasons previous to 1940–41.

A major point which seems definitely to be associated with this difference is the fact that comparatively large acreages of Dolichos beans were grown at this Station in the seasons 1934-35 to 1938-39 inclusive, but only small acreages were planted in the seasons 1939-40 and 1940-41, since when no Dolichos has been grown.

The correlation as stated, though not absolutely perfect is a sufficiently good one; and the deduction from it is that American bollworm populations in cotton have been smaller since the planting of Dolichos has ceased.

Further, there is mention in the 1938-39 report that Dolichos, if grown in close proximity to cotton, may in certain circumstances have the effect of attracting and thus increasing American bollworm egg laying on cotton. Again, about 1938-39 there was some doubt as to whether moths bred from the early laying which occurred in Dolichos did not contribute to the attack in cotton later in the season. This was not investigated fully owing to war-time circumstances. But in view of the possible dangers outlined, and the tendency for American bollworm populations to be smaller in a number of consecutive seasons in which no Dolichos has been grown, this crop will not be planted in future. With possibly a few exceptions Dolichos is not grown by farmers.

In view of recent evidence it seems possible that the rhythm in the incidence of American bollworm attack relative to maize and cotton, which has become apparent in the past two seasons may have been confused by the growth of Dolichos formerly.

Sudan Bollworm (Diparopsis castanea).—As in 1944-45 and several previous seasons the greater part of the crop loss which occurred in the pre-flowering period and during the first six to eight weeks of flowering was caused by Sudan bollworm. Larvæ were numerous throughout the season, more so than in 1944-45. In March, however, the attack diminished appreciably, coincident with the peak period of American bollworm populations. Subsequently the attack by Sudan bollworm again increased markedly, from about the end of March and throughout April. During this latter period the pest damaged a large number of the older bolls, thereby reducing yield in the nearly mature crop. In fact, in the past season 43% of the mature bolls showed damage due to bollworm punctures, most of which, by inference from the different but relevant records, was caused by Sudan bollworm larval attack. The comparable figure in the 1944-45 season was 8%.

Three points in the foregoing description of Sudan bollworm attack merit further comment. They are:—

(*a*) The relative magnitude of the attacks in 1945-46 and in 1944-45.

(*b*) The damage done to the important early crop of buds, flowers, etc,

(*c*) The tendency for populations to decrease during the period that American bollworm populations are highest.

That Sudan bollworm larval populations were larger in the past season than in 1944-45 is probably accounted for by the fact, established by previous investigations, that the main period during which moths emerge from over-wintering pupæ is from early November to early January. As, therefore, the 1945–46 crop produced its first flower squares and buds late in December and during January whereas this stage in crop development occurred about a month later in the 1944–45 season, the damage to the earlier crop, i.e. 1945–46, would tend to be greater.

That it is the setting and making of an early crop which is so important to final yields has been stressed frequently in past reports. Again, that the damage done by Sudan bollworm larvæ in the early crop to young flower squares and buds can be very real is apparent from the following extract from a report on Sudan bollworm by E. O. Pearson and B. L. Mitchell :—" Feeding experiments suggest that in reaching maturity a single larva will consume upwards of half a dozen full sized buds, but that a single fair-sized boll is a sufficient substitute." Presumably, a larger number of flower squares and small buds will be destroyed by a single larva, during the pre-flowering and early flowering stages in the crop.

That Sudan bollworm larval numbers usually decline during the peak period of American bollworm larval attack is a fact which has been noted in one of the earlier reports from this Station. The explanation then offered, namely that the American larvæ practise their cannibalistic habits on the Sudan larvæ, appears still to be reasonable.

Relative sizes of Sudan bollworm populations in a number of seasons both before and after 1939–40.—From the records it appears that in more recent seasons since 1939–40 Sudan bollworm populations have tended to be larger than formerly. It is possible that this increase may be due to the carry over from one season to the next of larger over-wintering pupal populations, which are the main source of tiding the pest over between seasons. It also seems possible that a change in agricultural practice at this Station may have contributed to the survival of an increased number of these pupæ. Thus prior to the 1940–41 season cotton lands of the previous season were ploughed and rolled in the dry months, and subsequently disc harrowed, after suitable rain in the November-December period, previous to the maize crop of the following season being drilled, in rows 3·5 feet apart, by ox-drawn machine. In more recent seasons, however, the maize crop following cotton has been hand planted at a check row spacing of 3·5 ft. × 3·5 ft. in land that has only been ploughed and rolled in the dry months. It is thought that the greater mechanical tillage of the land by disc harrow and planting machine in the seasons prior to 1940–41 possibly resulted in a greater destruction of over-wintering Sudan bollworm

pupæ. To test the validity of this theory the cotton lands of this past season are being disc harrowed both before and after ploughing ; and in addition, a small implement, Station-made, will be used in the old cotton lands in the November–December period. This implement is constructed so that two series of disc coulters are set in tandem, giving interval cuts of about one inch apart. The implement may be used for inter-row cultivations.

Counts were made of live Sudan pupæ in situ in the cotton lands before these were ploughed in July this year. The calculated mean populations per acre from a large number of random samples showed that there were as many as 29,000 pupæ per acre in one field of 35 acres and 24,000 pupæ per acre in another field of 11 acres. About 84% of these pupæ were found down to a depth of three inches in the surface soil. As already stated the main period of moth emergence from over-wintering pupæ is from early November to early January.

Sudan bollworm control investigations.—In the control of Sudan bollworm present methods in use are (*a*) the mechanical break-up of the previous season's cotton lands to destroy over-wintering pupæ, and (*b*) a close season in the October–early November period during which the growth of cotton is prohibited by law. Other methods of control which are being investigated are :—

Firstly, the introduction of photoperiodic type perennial cottons which show promise of being wholly vegetative in the summer months. These cottons will be tested as traps for the early egg laying in the November-January period. One such cotton which has good jassid resistance and which has shown promise for the purpose under consideration is Ecuador No. 5, ex the Trinidad type collection, the seed of which was obtained from J. D. Jameson, Senior Botanist, Uganda. Apart from Sudan bollworm, other possible dangers to be kept in mind in the growth of these cottons are the breeding of Spiny bollworm and jassid populations, even in small numbers, in the early part of a season. (The perennial cottons Moco and Tobago native previously used in similar investigations about 1933-34, proved to be unsatisfactory).

Secondly, as another possible method of control some of the newer insecticides such as ' Gammexane ' will be applied to the soil in an attempt to destroy larvæ, as they are about to pupate. The purpose of such control methods would be to prevent the formation of a large part of the over-wintering pupal population. Should that be possible, it might also be found that it is necessary only to apply this kind of treatment in every other or every third season. This line of investigation was suggested by B. L. Mitchell.

Any economically sound control measures which decrease the size of Sudan bollworm over-wintering pupal populations, thereby reducing the numbers of moths which enter the young crop, is of first importance in increasing the yield of cotton per acre. Such measures will enhance

greatly the value of breeding early fruiting strains, which are so desirable in view of American bollworm attack and climatic limitations later in the season.

Spiny Bollworm.—This bollworm was present in small numbers throughout the season ; it was most numerous in March.

Cotton Stainers.—The first few immigrant stainers were taken in early February. Total numbers of adults of the three species remained small until mid-April, after which time these populations increased, but only slightly, thereby reflecting the low rate of breeding which took place in the crop. Fifth instar nymphs were first seen about mid-March, but their numbers remained small.

Adults of *Dysdercus superstitiosus* occurred in very small numbers compared with *D. fasciatus* and *D. intermedius*, whilst *D. fasciatus* was generally more numerous than *D. intermedius ;* especially was this the case in the later stages of the infestation. As usual *D. fasciatus* bred to a greater extent than did *D. intermedius*, as judged by the size of the respective fifth instar populations of these two species.

About 23% by weight of the Station's crop was graded as stained seed cotton. The corresponding figure for the 1944–45 season was 12%. The increase of 11% in the amount of stained cotton (all grades) picked in the past season compared with the 1944–45 figure is attributed indirectly to the increase mainly in Sudan bollworm damage to the larger bolls rather than to an increase in stainer damage.

Owing to a change in the method of analysing staining damage in the past season there is no figure directly comparable with that of 8% which referred to staining damage in the 1944–45 report.

Aphis.—This insect was quite prevalent on groups of plants during February, but no general attack by the pest developed.

Termites.—There was a negligible amount of damage done by termites during the season.

Root Knot Nematode.—Through the courtesy of the Tobacco Research Board and the very ready co-operation of Mr. B. L. Mitchell a number of Gatooma-bred strains representing three main family groups, were tested for their resistance to tobacco eelworm. The results of Mr. B. L. Mitchell's work are given in full in Part II of this Report. In brief the main conclusions arrived at are :—

(*a*) That all eight strains under test became only lightly infested with eelworm when grown in soil which was known to be very heavily infested by the pest, and

(*b*) That there is an intolerance in cotton rootlets to eelworm galling which is probably why the infestation of tobacco following cotton is so much reduced.

Mycology.

Alternaria.—The leaf symptoms of this disease were quite prevalent in the young crop during the latter half of January and in February until rains ceased. The abundant rainfall coupled with overcast skies, characteristic of this period, provided ideal conditions for the development of the organism. As already noted, the disease was most prevalent in about six acres of cotton which had not received compost.

In the nearly mature crop in one field, premature leaf fall caused by *Alternaria* occurred earlier, and to a greater extent, in certain progeny rows and strains. But there was no such difference among the same strains growing on better soil.

In the coming season the effects of certain potash and compost treatments, similar to those used at Barberton, will be tested for their possible usefulness in increasing cotton yields in the presence of *Alternaria*. The results of this trial will depend on a sufficient natural infection by *Alternaria*.

There is some doubt as to the actual amount of loss caused by *Alternaria* in the young crop. Published evidence shows that the young growing leaves may be infected easily by superficial application of the organism, whilst bolls, even in their young stages of growth, are not likely to be damaged by superficial infection. But, in the literature available, there is no reference to the possible ease with which *Alternaria* may infect, and so damage, the very young flower squares and terminal buds, more particularly the growing points of the sympodia. If these latter plant parts can be as readily infected as are young leaves, then the damage done by *Alternaria* in the young crop is probably greater than has hitherto been realised. Information on the point in question would be appreciated.

A certain amount of premature leaf fall in the nearly mature crop is probably an advantage, in that such loss of leaf not only accelerates boll maturity, but also reduces shade, and so hinders the activity of insect pests, such as stainers.

Angular Leaf Spot.—A negligible amount of Angular leaf spot was observed in strains of U.4 origin, but the Blackarm stage of *B. malvacearum* developed on a small percentage of the plants in the Sea Island crosses from Barberton. *B. malvacearum*, never of much importance in the U.4 strains grown locally, is likely to be of even less moment in future, as cotton seed for planting is now treated with sulphuric acid on a commercial scale.

Summary and Conclusions.

In the past season (1945–46) good planting rains fell early, about the middle of November, 1945. Furthermore, weather conditions generally remained very favourable during germination and also

during the early stages of plant development, until the time that the first flower squares were being produced. Subsequently, however, a too-abundant rainfall during the first weeks of flowering caused a certain amount of water-logging and also favoured the development of *Alternaria*. Finally, rains ceased for all practical purposes about mid-February, some five weeks after the start of flowering and about three months after planting.

Excellent plant stands of the order of 90% of a full stand were obtained ; but this advantage was largely offset, mainly by the damage caused by Sudan bollworm through the season, and particularly in the pre-flowering (" squaring ") and early flowering stages. During this early flowering period, *Alternaria* may have been a factor contributing to crop loss.

Only light damage was done to the crop by American bollworm which attacked mainly in March. As moisture supplies were then decreasing it is possible that the small crop loss caused by American bollworm would in any event have occurred, partly on account of dry weather conditions, and also partly owing to an increasing attack by Sudan bollworm.

For the second season in succession American bollworm larval populations definitely started to increase in the sixth week after flowering had first commenced. For reasons given, this increase in both seasons could have been originated by a generation of moths bred in the main maize crop, planted about the same time as the cotton. This possibility will be investigated further, and in addition closer observations will be made of this bollworm's habits in maize with a view to reducing larval populations in this crop.

There has been a definite trend, firstly, for Sudan bollworm populations to be larger and, secondly, for American larval populations to be smaller since 1939-40 season ; possible reasons for such trends are discussed in the case of each of these pests.

The insect pest problem which is of first importance at present, is how best to reduce further the initial Sudan bollworm populations in the young cotton crop. In this connection an outline is given of the different investigations in progress. It is considered that any economic control measures, which may cause a greater reduction in the size of these initial populations, would enhance considerably the value of both breeding for earliness in strains, and also of early planting of the cotton crop. These two measures are very essential to the minimising of loss through American bollworm damage later in the season. Conversely, any advantages gained by breeding for earliness, or by early planting, will be lost if initial Sudan bollworm populations are large.

A range of the Gatooma strains of cotton has been shown to be very resistant to galling by tobacco eelworm. A full report on this work is given in Part II.

Several derivatives of the 7C group of strains gave a higher yield of lint per acre than 9L34, the strain at present in cultivation. But the lint of these is not quite up to the standard of 9L34. Thus no strain to replace 9L34 is available immediately.

PROGRAMME FOR 1946-47.

A crossing programme aimed at a measure of improvement of lint quality of the Gatooma strains is to be started.

Measures which might give a better control of Sudan and American bollworms, especially Sudan, are likely to result in a more marked increase of lint per acre than the smaller, but none the less important, gains which may be derived from further work aimed at increasing the earliness and fruiting potentialities of strains with better lint.

Additional to the investigations on insect pests and plant breeding as outlined in the foregoing paragraphs, work is also in progress on the following :—

(*a*) Rain-grown grasses which may be of most benefit in the agricultural system to the cotton crop.

(*b*) The effect of certain manurial treatments which may hinder the development of *Alternaria* in cotton.

PROGRESS REPORT—Part II.

TESTS FOR EELWORM RESISTANCE IN VARIOUS COTTONS.

Copy of Report by B. L. Mitchell,
Entomologist, Tobacco Research Station, Trelawney.

During the past two seasons (1943–44 and 1944–45) it has been found that the strain of cotton 9L34 from the Cotton Breeding Station, Gatooma, was highly resistant to eelworm. Major Cameron of the Cotton Research and Industry Board, therefore, offered to supply seed of the various strains of cotton which have reached the large bulk stage to determine whether they were equally resistant.

The following strains of cotton were tested.

TABLE I.

A List of the Cotton Strains used in the Trial.

Strain No. 1.	12348	all 9L34 family group.
2.	12270	
3.	12347	
4.	1222	all 7L5 family group.
5.	12219	
6.	12231	
7.	12405	Both 7C family group being crosses between U.4s and Cambodia in 1937.
8.	12490	

A randomised block lay-out was designed, each plot being a single row 12 yards long and each strain replicated 8 times. A piece of land was chosen which was known to be very heavily infested and the cotton planted at a spacing of 3 feet between rows and 12 inches in the row. The plants were thinned to 3 plants per hole at 5 weeks after sowing. The cotton was planted on 13th December and refilled on 2nd January. It was uprooted and examined for eelworm galls on 9th and 10th April. The eelworm infestation was graded by the method described by Jack (Trelawney Tobacco Research Station, Annual Report, 1945).

Plant growth was extremely poor throughout and no attempt whatsoever was made at forming a crop. An average of 320 plants was examined in each strain.

TABLE II.

Showing the Percentage Eelworm Infestation of the various Strains of Cotton.

Strain No.	*Infestation as Mean of 8 replications.*	*% of Mean.*
12348	17·2	96·8
12270	20·6	115·5
12347	22·0	123·4
1222	15·3	85·8
12219	13·6	76·6
12231	16·0	89·5
12405	20·1	113·0
12490	17·9	100·6

There was no significant difference between any of the strains, the mean infestation being 17·8%.

The eelworm galls which were formed on these cottons differed from the typical forms as seen on tobacco and sunflowers. No large or permanent galls were observed at all. The roots are intolerant of gall formation. Only tiny galls were present and these were always on the smallest of the fibrous rootlets. The infected rootlet dies soon after the gall is formed, rots, and becomes detached from the main root. This habit caused some difficulty in the recording of the eelworm infestation as, in the first place, it is not easy to remove from the soil the whole of the root system even when the fine roots are healthy, whilst when these rootlets are infected with eelworm and disintegrating they are even more liable to break off and remain in the soil. It is therefore probable that the absolute figures arrived at for the infestation of these cottons are an underestimate.

It is believed possible that this intolerance of the cotton rootlets to eelworm galling may be the key to the reason why the infestation of tobacco following cotton is so much reduced. The rootlets may act as a trap crop, becoming infected with eelworm but being shed from the plant before the nematode has time to reproduce. If this is the case then the eelworm population would be absorbed and destroyed.

ANGLO-EGYPTIAN SUDAN.

PROGRESS REPORT OF THE PLANT BREEDING STATIONS, SEASON 1945-1946.

BY

R. R. ANSON, R. L. KNIGHT, S. H. EVELYN AND M. F. ROSE,

PLANTING AND PICKING DATES.

Area.	*Average Planting Dates.*	*Average Picking Dates.*	*Close Season.*
Gezira	10th Aug.–15th Sept.	30th Dec.–1st April	15th April–10th Aug.
Gash Delta	20th Aug.–20th Sept.	10th Jan.–30th April	30th April–20th Aug.
Tokar	7th Sept.–15th Oct.	1st Jan.–31st May	1st June–20th Aug.
Kordofan	15th June–15th Aug.	15th Oct.–1st March	1st March–15th June
Zeidab	1st May–15th May	1st Sept.–30th Sept.	1st Jan.–30th April
Equatoria	15th May–31st Aug.	1st Oct.–15th Feb.	—

INTRODUCTION.

The general policy of the Cotton Breeding Section has been given in previous seasons' Reports and remains unchanged.

Mr. Anson is responsible for administration and policy and has been in control of the testing and propagation of Egyptian varieties. Dr. Knight has been in charge of hybridization and gene-transference. Mr. Evelyn has carried out all Egyptian breeding, dura breeding and the statistical reduction of tests of Egyptian varieties and of dura. Mr. Rose is now in charge of American breeding work.

During the season the Section was visited by Professor Sir Frank Engledow and Sir Harold Tempany. Visits from members of our Scientific Advisory Committee are very helpful and greatly appreciated. We hope this is a prelude to further visits from them and other members of the Committee. Mr. Lord, of the British Cotton Industry Research Association (Shirley Institute), was another of our visitors and we would like to take this opportunity of expressing our appreciation to his Director for enabling this form of co-operation to take place. Discussions with Mr. Lord were of considerable value to all the members of the Section and we hope that it will be possible for him to visit the Sudan again in the not too distant future.

Mr. J. B. Hutchinson has also spent a considerable time in the Sudan this year and we look forward to seeing him here on a more permanent basis.

Other visitors included Mr. Mohammed Afzal of Lyallpur, Mr. Peat of Tanganyika, Dr. Roberty of the French Colonial Scientific Service, and Mr. Gressl from the U.N.S.D.A.

STAFF.

Mr. M. F. Rose arrived in the Sudan on the 5th November, 1945, on transfer from Barberton Station, Transvaal..

Mr. J. Steven was transferred from the Field Division of the Department of Agriculture and Forests to the Research Division to fill the newly created post of Plant Propagation Inspector. He reported for duty on 1st August, 1946.

A word of praise must be given to the Sudanese Government Technical Staff of the Plant Breeding Section, who under difficult conditions carried out this heavy programme of work in an excellent manner. The excellent work of Hassan Effendi Osman El Nur and Yacoub Effendi El Sayegh who were in sole residence at the Kadugli Station until Mr. Rose's arrival and again when he was on leave, deserves special mention. Not less important was the work of Mohamed Effendi Taha, Senior Technical Assistant in the Section at the Gezira Research Farm, and Mahmoud Effendi Abdel Nabi, who is Dr. Knight's principal assistant at Shambat and has charge of a great deal of the highly technical genetic work which is being carried out there.

THE GEZIRA STATION.

BY

S. H. EVELYN.

Meteorology.

Rains, in general, were badly distributed and total precipitation was sub-normal in almost every part of the Gezira.

Below are given monthly rainfall data from twenty-eight Gezira "blocks" compared with the normals for 1927–1944 (in brackets): March to May inclusive, 43.5 mm. (18 mm.); June, 9 mm. (34 mm.); July, 65 mm. (133 mm.); August, 126 mm. (133 mm.); September, 54 mm. (57 mm.); October, 20 mm. (15 mm.); November onwards, nil. The total rainfall for the year was 317 mm. as compared with an average of 390 mm.

At the Gezira Research Farm rain distribution was similar to the above and total precipitation was 252 mm. as compared with the average for the period 1919–1945 of 396 mm.

Heavy early rains, such as were experienced this season, are disadvantageous since they promote strong weed growth which depletes soil nitrogen before the cotton and dura crops are sown.

Inherent Agricultural Circumstances.

The season was poor compared with last year, and climatic conditions were such that the plants remained stunted for a long time with the result that yields were reduced.

At Tokar, which grows X.1730A, there was a conspicuous absence of diseases and pests except for a severe locust attack which considerably depressed the yield.

At the Gash, where the seed for sowing the Gezira and White Nile Alternative Livelihood Schemes is produced, there was a considerable increase in both blackarm and leaf curl and locusts were also severe. Consequently yields were considerably reduced. The seed supply for the next season's Gezira crop was endangered since the seed from large areas was condemned because of blackarm infection. It will be necessary to make up this deficit from last season's stock of Gash seed. Unfortunately the 140-acre isolated propagation plot of Evelyns Selected Domains Sakel (Selection No. 1) was so severely damaged by locusts that the bulking of it in the Gezira next season will have to be drastically curtailed.

In the Gezira and White Nile Alternative Livelihood Schemes, cotton boll opening was later than usual, mainly due to an early bollworm attack which caused considerable flower-bud shedding. Top-crop formation was earlier than usual indicating an early cessation of growth and, consequently, poor yields. Bolls did not open well, and many of those formed at the ends of sympodia failed to mature. The grade of the crop was, in general, below average. On good soils the later maturing varieties, X.1730A, BAR.1730L, BAR.4/5 and BAR.4/11, produced heavy secondary growth which would have given a substantial increase in yield but for the " Cotton Close Season."

Genetics and Breeding.

At the Gezira Research Farm, progeny row selection and " filtering " followed the same lines as were introduced by the writer in 1942. Results were excellent in spite of the bad season and a great number of progenies, " filtered " X1730A and blackarm-resistant varieties, will be carried forward next season either in the breeding plot or in isolated bulk-plots at the Gezira Research Farm.

Selections for earliness (low node number) in Domains Sakel showed great promise and a large number of single-plant progenies, with node numbers as low as six, will be tested next season.

The random " filtering " of Domains Sakel, X.1730A and the blackarm-resistant X.1730 varieties gave excellent results and this work continues. Lint samples will be sent to the Shirley Institute for hair and spinning tests. Lint samples from the isolated bulk plots of the writer's " filtered " Domains Sakel gave superior hair characters and spinning results to the Commercial Domains Sakel control. Tests carried out by the Sudan Plantation Syndicate Chief Classifier, showed the " filtered " material to be more regular, slightly longer, stronger and finer than the Commercial Domains Sakel control. Four hundred acres of this " filtered " material will be bulked in isolation at the Gash next season and it will again be tested in the variety trials for yield and performance, under S.P.S. conditions, in the north, centre and south of the Gezira. In addition, the S.P.S. is testing it on a large scale at certain of its Domains Sakel Blocks.

A picking-date series of single bolls of Domains Sakel was sent to the Shirley Institute, at Mr. Lord's request, to determine how hair fineness is built up and affected by time of season. The series included

bolls from twenty days old to maturity with intervals of ten days. The results so far obtained have been so promising that another series, with slight modifications, will be sent next season for further investigation.

The Hairy X.1530 progenies again showed partial resistance to jassids and received a good spinning report. They are high-yielding with a high ginning outturn and are now pure for hairiness and for X.1730A staple-length and strength. Improved progenies will be grown next season.

Leaf Curl Resistance.

Employing the same technique as was introduced by the writer in 1942, a number of resistant Domains Sakel (R.D.S.) and Masseys Domains Sakel (R.M.S.) progenies were grown at the Gezira Research Farm and at Shambat and compared with commercial Domains Sakel in a random block layout with 10 replications. As formerly each resistant plant was surrounded by " Spreaders " (S) and the whole experiment was belted with " Spreader " material. Unfortunately, through theft, all selfed material of the previous season was lost and so the experiment had to be sown with unselfed seed ; however, as outcrossing was apparently not very high in the parent material only a few of the progenies were seriously affected.

As only a very small leaf curl infection occurred at Shambat the results at this site were not worth analysing and the data which follow were obtained only from the Gezira experiment.

Mean Percentage Infection of Resistant (R) Progenies and Control at 14/3/1946.
(*i.e. Before the plants were cut back*).

No. 3 *RDS/* 8-2	*No. 2* *RDS/* 3-5	*No. 5* *RMS/* 1-1	*No. 8* *RMS/* 6-4	*No. 7* *RMS/* 6-2	*No. 6* *RMS/* 6-1	*No. 4* *RMS/* 8-4	*No. 9* *RMS/* 7-2	*No. 1* *RDS/* 2-5	*No. 10* *Com.D.S.* —
12·0	12·5	15·3	16·0	20·5	25·0	27·0	28·0	42·0	51·5
51·0	49·0	48·0	57·0	54·0	48·5	56·0	47·0	60·0	68·5

(*a*) Progeny differences were highly significant at the 0·1% level and the significant difference was 17·6%. Progenies within the same bracket do not differ significantly. Only progeny No. 1 was not significantly more resistant than the Control.
(*b*) The " Spreader " infection in the same sub-plots is recorded below the main data for comparison.
(*c*) The parent of No. 1 was probably outcrossed to a " Spreader " in the previous season.
(*d*) The total number of " R " plants (including Control) infected was 121 or 24·6% and of " S " plants 265 or 54%.
(*e*) Block differences were not significant. This is unusual but has a probable explanation in the variability of the direction of the wind during the month of October.

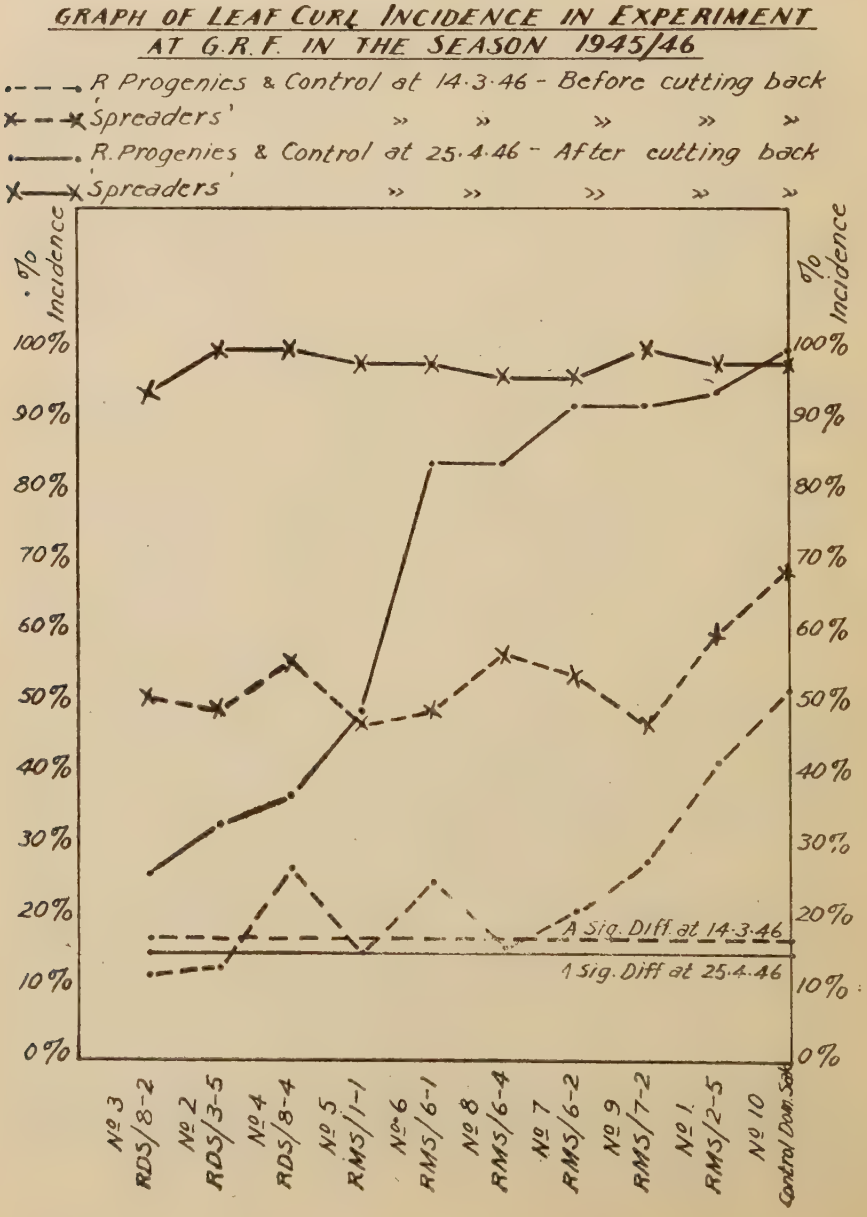
Mean Percentage Infection of Resistant Progenies and Control at 25/4/1946.
(*i.e. after the plants were cut back on* 15/3/46).

No. 3 *RDS/* 8-2	*No. 2* *RDS/* 3-5	*No. 4* *RDS/* 8-4	*No. 5* *RMS/* 1-1	*No. 6* *RMS/* 6-1	*No. 8* *RMS/* 6-4	*No. 7* *RMS/* 6-2	*No. 9* *RMS/* 7-2	*No. 1* *RDS/* 2-5	*No. 10* *Com.D.S.* —
26	33	37	49	84	84	92	92	94	100
94	100	100	98	98	96	96	100	98	98

(*a*) Progeny differences were highly significant at the 0·1% level and the significant difference was 14·8% thus progenies within the same bracket do not differ significantly. Progenies 3, 2, 4, 5, 6 and 8 were significantly more resistant than the Control.
(*b*) The " Spreader " infection in the same sub-plots is recorded below the main data for comparison.
(*c*) It is probable that the parents of Nos. 6, 8, 7, 9 and 1 were out-crossed to " Spreaders " in the previous season.
(*d*) Total " R " infection (including Control) was 339 plants or 68·7% and " S " infection 480 or 97·8%.
(*e*) Block differences were not significant probably because of the reasons stated above.

On analysis the disease-free plants were normal for seed weights, staple length and quality, but lint weights per seed and total seed-cotton yields per plant were generally above average.

It is very apparent that resistance genes do exist in both Domains Sakel and Masseys Domains Sakel and that selection in the above manner is having a decided positive effect. As in the past disease-free plants of the most resistant progenies will be chosen from the worst infected blocks for next season's material. The following graphs have been prepared to illustrate, more clearly, the season's results.



The Egyptian Variety Trials (S. H. Evelyn and R. R. Anson).

Replicated variety trials were carried out at Tokar and in the north, centre and south of the Gezira. At each site the random block layout was employed with 10 replicates and the tests were grown under strictly commercial conditions. As the BAR.NT.2 strains have now been discarded as possible commercial varieties the five of them tested in the Gezira have been omitted from the results and the one tested at Tokar is only given for the purpose of future record. Lint yields of the Gezira trials were not analysed as the lint of each picking was required for hair and spinning tests.

Tokar.

Yields of Seed-cotton (in pounds per acre).

X1730A	BAR.N.T.2/41	
1125	847	The significant difference was 111 lb. per acre.
100%	80%	

Yield differences were highly significant at the 1 per cent. level and in favour of X.1730A. The tall, spindly, open growth of BAR.NT. 2/41 is not as suitable to the windy, sand-blown Tokar conditions as the shorter, bushier and more compact habit of X.1730A which not only stands up to the winds but covers the ground quicker and so reduces weed growth.

Turabi Block (North S.P.S. Area).

Yields of Seed-cotton and Lint (in pounds per acre) and Ginning Outturns.

	Comm. Dom.	*X*	*BAR.*	*BAR.*	*BAR. 1730L*	*Dom. Sak.*	*BAR.*	
Varieties... ...	Sakel	1730A	1730L	4/5	Sel–1	Sel–1	4/11	The significant difference was 127·5 lb. of s/c per acre.
Seed Cotton (lb. (per acre) ...	930	918	892	834	820	817	796	
S/c as % of Dom. Sak. ...	100	98	96	88	86	86	83	
G.O.T. % ...	31·3	34·2	35·6	31·9	34·3	30·7	32·3	The coefficient of variation was 15·9%.
Lint (lb. per acre)	292	314	318	266	282	251	257	
Lint as % of Dom.Sak. ...	100	108	109	91	97	86	88	

In seed cotton yield a significant varietal difference only occurred between Commercial Domains Sakel and BAR.4/11.

A fair incidence of primary blackarm disease occurred in the Selected Domains Sakel plots, which were sown with seed produced at the Barakat Seed Farm, and to a lesser degree in the Commercial Domains Sakel and X.1730A plots both of Gash origin. The BAR. strains showed relatively little infection and did not shed their leaves.

Gezira Research Farm (Centre S.P.S. Area).

Yields of Seed-cotton and Lint (in pounds per acre) and Ginning Outturns.

Varieties.	*X*	*BAR. 1730L*	*BAR.*	*BAR.*	*BAR.*	*BAR. 1730L*	*Dom.*	*Dom. Sak.*	*Dom. Sak.*	
	1730A	Sel–1	1730L	4/11	4/5	Sel–2	Sak.	Sel–2	Sel–1	A significant difference was 53·1 lb. of s/c per acre.
S/c (lb. per acre)	1,142	1,091	1,089	1,088	1,062	1,046	998	992	960	
S/c as % of X.1730A ...	100	96	95	95	93	92	87	87	84	The coefficient of variation was 6·4%.
G.O.T. % ...	33·8	34·8	35·2	29·7	30·8	32·5	30·3	30·5	30·2	
Lint (lb. per acre)	386	364	384	355	335	350	302	305	290	
Lint as % of X.1730A ...	100	94	9	92	87	91	78	78	75	

Varietal differences were highly significant at the 0·1% level. Strains within the same bracket did not differ significantly, thus there was no significant difference between the Selected and Commercial Domains Sakels and none between BAR. 1730L, BAR. 1730L Selection 1 and X.1730A.

Blackarm and leaf curl diseases were negligible but bollworms caused a high percentage of shedding of first-formed buds and bolls and this, coupled with adverse climatic conditions and severe damage from thrips and jassids, reduced yields considerably.

HAG ABDALLA BLOCK (SOUTH S.P.S. AREA).

YIELDS OF SEED-COTTON AND LINT (IN POUNDS PER ACRE) AND GINNING OUTTURNS.

Varieties.	*X 1730A*	*BAR.1730L Sel–1*	*BAR. 4/11*	*BAR. 1730L*	*BAR. 4/5*	*Domains Sakel*
S/c (lb. per acre) ...	1,151	1,117	1,060	1,013	1,012	974
S/c as % of X.1730A	100	97	92	88	88	85
G.O.T. (%)	33·8	33·7	32·1	35·1	31·8	30·5
Lint (lb. per acre) ...	389	377	341	356	322	297
Lint as % of X1730A	100	97	88	91	83	76

The significant difference was 81·5 lb. of s/c per acre.
The coefficient of variation was 8·3%

Varietal seed-cotton yield differences were highly significant at the 0·1% level. Varieties within the same bracket do not differ significantly thus X.1730A significantly outyielded BAR.4/11, BAR. 1730L and BAR.4/5 but not BAR.1730L Selection 1.

Growth was slow because of adverse climatic conditions but total rainfall was higher than at Turabi or Gezira and rains were more evenly spread. There was a slight incidence of primary blackarm disease but this dried out and never spread through the experiment. Other diseases and pests were negligible.

PROPAGATION (R. R. ANSON).

Evelyn's Selected Domains Sakel (Selection No. 1) was propagated on small increase plots of 140 acres and 60 acres, situated at the Gash and on the Barakat Seed Farm respectively. Both sites were well isolated from other cotton. Unfortunately the season was poor and this, coupled with a severe locust attack in the Gash, resulted in low yields. There will, however, be sufficient seed from the Gash for testing in all varietal trials and for sowing 90 acres at Kab el Gidad Block (North S.P.S. area) to be tested against adjacent areas of Commercial Domains Sakel. This will still leave enough seed to bulk a further 40 acres in isolation at the Barakat Seed Farm.

The seed obtained from the Barakat Seed Farm this season (60 acres mentioned above) will be sufficient to test 138 acres of Selected Domains Sakel against adjacent areas of Seed-Farm-grown Commercial Domains Sakel and in addition, to sow 400 acres in isolation at the Gash next season.

Furthermore, large increase plots of BAR.1730L (1215 acres), BAR.1730L (Selection 1) and BAR.4/5, (totalling 840 acres), were

bulked in isolation, and have provided a large reserve of pure seed to be drawn on for future large-scale tests against susceptible types and for testing in varietal trials. They have also provided sufficient lint for testing commercially.

HAIR AND SPINNING TESTS AND BROKERS' VALUATIONS (S. H. EVELYN)

Unfortunately, reports on the 1945/46 Variety Trials have not yet been received, but some tests have been done on Selected Domains Sakel, the blackarm-resistant X.1730 strains and the jassid-resistant N.T.2 strains.

Domains Sakel Selection I compared with Commercial Domains Sakel.

Comparisons between the Selected and Commercial Domains Sakel were made by the Chief Classifier of the S.P.S. Ltd. and can be generally summarized as follows :—The selected samples were slightly longer, of better regularity, strength and cohesiveness, finer, rather less wasty and in general appearance better, brighter and of lighter colour than the controls. There was no difference in lustre and silkiness. In general, the Selected was a slightly better cotton than the Control.

In the Shirley Institute's Report No. 403, in which samples from Selected Domains Sakel grown on a four-course rotation at the Barakat Seed Farm are compared with Commerical Domains Sakel grown under a three-course rotation at Gezira, there was little to choose between the two strains in either hair or spinning characters.

In a report submitted by Messrs. Wolstenholme and Holland on comparable samples obtained in the 1945/46 season, valuations for Grades 1 to 4 of Selected and Commercial Domains Sakel were almost identical. Grade 1 of the Selected was valued at 50 points on Grade 1 of the Control and the reverse was the case in Grade 4. Grades 2 and 3 received identical valuations.

Domains Sakel Selection II compared with Commercial Domains Sakel.

The Shirley Institute's report on samples from the 1944/45 season showed the Selection to be finer, stronger at all spinnings and giving higher standard counts than the Control. In all other respects they were identical.

Blackarm-Resistant BAR.1730L compared with Commercial X.1730A.

Dr. Knight in his section of the Report gives a table of comparison of the hair and spinning values of these two strains which demonstrates that there is nothing to choose between them. Actually in the last report received from the Shirley Institute (No. 403) samples of BAR.1730L were classified as slightly finer, stronger and of better appearance than the commercial X.1730A controls. The Broker's report on comparable samples obtained in the 1945/46 season, however, gave a mean value of 17·44 pence per pound for X.1730A as against 16·41 pence per pound for BAR.1730L.

Blackarm-Resistant BAR.4/5 compared with Commercial X.1730A.

Reports on the 1945/46 season's samples can be summarized as follows:—That, though differences between the two strains were small, samples of BAR.4/5 were slightly more even and less neppy than X.1730A at 80's and 100's and, though identical in strength and showing little difference in spinning quality, BAR.4/5 had a slight advantage in yarn appearance. The Broker's reports on the same samples gave X.1730A a mean valuation of 17·44 pence per pound as against 17·15 pence per pound for BAR.4/5.

Blackarm-Resistant BAR.4/11 compared with Commercial X.1730A.

The hair and spinning test reports on these strains have shown X.1730A to be slightly superior to BAR.4/11 in all major characters, but the broker's report of these two strains gives BAR.4/11 a mean value of 17·25 pence per pound or only 0·19 pence per pound less than the mean value of X.1730A.

Hair and Spinning Test Results on Cotton Samples Grown in the 1944/45 Season at the Gezira Research Farm in an Experiment to Test the Jassid Resistance of X.1530 Hairy and Hairy-Backcrossed NT.2 Strains Against Non-Hairy Controls.

The Shirley Institute's Small-Scale Spinning Test Report No. 95 of 11/6/46.

Variety.	*Length Characters.*			*Immaturity.*		*Fibre Wt. per cm.*		*Mean of two spinnings.*			
Samples spun at 80's Twist Factor 3·5 JR=Jassid Resistant	Mean 32nd ins.	Effective 32nds ins.	% Short Fibre	N–D	Maturity Ratio	Mean	Standard	Lea Strength lb.	Count	Lea. count Strength Product	Prod. corrected for count diff.
X.1530 (Hairy) ...	38	52	25	66–9	0·985	159	161	28·1	80·2	2,254	2,258
X.1730A (Cont.)...	32	49	36	68–7	1·005	161	160	25·2	78·4	1,976	1,947
Dom.Sak ,, ...	37	51	27	71–7	1·020	136	134	29·4	81·0	2,381	2,399
NT.2/39 ,, ...	34	50	31	73–6	1·035	155	150	27·8	79·2	2,202	2,188
JR.9/3	36	54	35	67–7	1·000	167	167	26·8	80·6	2,160	2,171
JR.9/4	38	54	29	71–6	1·025	174	170	28·3	77·9	2,205	2,167
JR.9/7	35	51	33	76–4	1·060	180	170	27·1	79·3	2,149	2,136

The Shirley Institute states : " The standard fibre weights of the three JR samples are higher than Domains Sakel or NT.2/39, falling within the range of those usually given by samples of X.1730A. The lea-count strength products of the JR and X.1530 (Hairy) samples are such as would be expected from cottons having similar fibre characters. The Domains Sakel is rather stronger and the X.1730A and NT.2/39 samples are weaker than would be expected from the fibre characters. The yarns were placed in the following order of appearance, (1) X.1530 Hairy, (2) Domains Sakel, JR.9/3 and JR.9/4, (5) JR.9/7, (6) X.1730A and NT.2/39. The strongest yarn was given by Domains Sakel and the weakest by X.1730A, of the rest, X.1530 (Hairy) was a little stronger than the others which were similar to each other in strength. In appearance also X.1530 (Hairy) and Domains Sakel were the best, though JR.9/3 and JR.9/4 were practically as good. The yarns from

X.1730A and NT.2/39 were the poorest in appearance. Thus on the whole the Sakel was the best sample and X.1730A the poorest."

This report is very encouraging as it was thought that the hairy gene in the JR strains would probably have been linked with lint coarseness and it is pleasing to note that by selection I have been able to raise the standard of X.1530 (Hairy) almost to that of X.1730A ; actually in the above tests it is better. The X.1530 (Hairy) strain is a so-called mutant found by Mr. H. E. King, but is more likely to be an outcross of X.1530 to Tanguis. Selection in the last few years has raised its mean length from 40 mm. to 45 mm., purified it for hair density, high lint index (7·6 gm.) and very high ginning outturn. The JR strains are of NT.2 type with the main Tanguis hairiness gene added.

Summary.

Selections for earliness in Domains Sakel showed great promise and a large number of plants with node numbers as low as 6 will be tested next season.

Filtering Domains Sakel, X.1730A and BAR.X.1730 varieties gave excellent results and this work continues. Lint samples from filtered Domains Sakel gave superior hair characters and spinning results to the Commercial Domains Sakel.

Work on breeding for Leaf Curl resistance in Domains Sakel was successfully carried a stage further.

PROGRAMME FOR 1946-1947.

The systems of selection, purification by filtering and the work on leaf curl disease and jassid resistance will follow the same lines as were laid down in the 1942–43 season. No further work, however, will be done on the NT.2 strains and this will allow more intensive observations on Domains Sakel, X.1730A and the BAR.1730 strains. Early-maturity studies and the dated-picking series of single bolls for "fineness" tests at the Shirley Institute will be continued. Lint samples of both Domains Sakel and X.1730A which have been (*a*) picked and stored in shade, (*b*) picked and left in the sun, (*c*) left on the plants till the end of the season and (*d*) picked earlier than usual, will be submitted to the S.P.S. graders and also for small-scale hair and spinning tests to determine how such factors affect grade, hair characters and spinning behaviour. Plots of Domains Sakel and X.1730A will be treated with aero leaf-defoliant to determine whether such treatment is effective under Gezira conditions.

Variety Trials at Turabi, Gezira Research Farm and Hag Abdalla—north, centre and south of the S.P.S. area, respectively, will be carried out. In these, Commercial Domains Sakel will be compared with Domains Sakel Selections 1 and 2; X.1730A Gash origin, with X.1730A Tokar origin, and both with the blackarm-resistant strains BAR.1730L Selection 1, BAR.4/5 and BAR.4/11. Graded lint samples of these will be submitted for hair and spinning tests.

Domains Sakel Selection 1 will be bulked up in the Gash and in the Syndicate area and its yield and lint quality compared with Commercial Domains Sakel. No other bulking is being done.

SHAMBAT STATION.

BY

R. L. KNIGHT.

Introduction.

The basic work of this station remains the direct application of genetics to plant breeding problems. In the past the main emphasis has been on breeding for resistance to Blackarm, *Bact.* (*Xanthomonas*) *malvacearum*, generally by inter-specific gene transferences. As these transferences reach completion, one by one, the resistant material is sent out to the plant breeders at Medani and Kadugli for testing, and for " filtering " in their breeding plots when this seems desirable.

With the acceptance of BAR.SP.84 as the commercial type for Kordofan and Equatoria provinces, it has been possible greatly to reduce the work on blackarm resistance in other Upland types. This, coupled with the elimination of NT.2 and its derivitives from the programme, has enabled more and more time to be devoted to other fields of work.

Of the possible lines of work, two are outstanding—jassid resistance and pink bollworm resistance—and accordingly the genetic investigation of hairiness of a range of types and of the pink bollworm resistance of *Gossypium thurberi* and *G. armourianum* are receiving increasing attention.

Meteorology.

Rains started in May, fully a month earlier than usual, and continued well into September. The total rainfall for the year was 8·9 inches and this was well distributed throughout the early growing period of the crop so that blackarm infections " took " well. The only exception with regard to ease of blackarm infection in the in-season crop, was an acre of Asiatic hybrids sown at the beginning of July. These families had to be sprayed with disease on three separate occasions because each time the disease developed, a dust storm blew the infected leaves off before grading was complete.

Temperatures were lower than last season. In the period from 1st May, 1945, to 30th April, 1946, inclusive, there were 194 days when the shade temperature registered 100°F. or over, but only 31 days with 110°F., or more, and no days with a temperature of 115°F., or over. These figures compare with 198, 45 and 6 days respectively,, for the previous season. These lower temperatures resulted in a more successful out-of-season crop than that in the previous year.

Genetics and Breeding.

Production of Blackarm-resistant "Egyptian" Varieties.

1. Blackarm-resistant Domains Sakel.—Using Mr. Evelyn's latest Domains Sakel "filtered" selection as the recurrent parent, the transference (from blackarm-resistant NT.2) of the resistance genes, B_1, B_2 and B_3, was carried to the fifth backcross stage and seed of sixth backcross type has been produced for sowing in 1946–7.

It is unlikely that further backcrossing will be necessary and it is proposed to self-out homozygous lines for each of the three factors next season, as the first step in integrating a type carrying B_1, B_2, and B_3. Meanwhile, seed was produced in 1945–6 winter for sowing, next season, a small propagation plot of Domains Sakel type homozygous for B_2. This first propagation area will be of fourth backcross origin and the intention is solely to see how the transference is progressing, by checking up on lint quality and yield in replicated tests. For comparison, a susceptible bulk has also been selfed out from the fourth backcross material.

2. Blackarm-resistant NT.2.—The whole range of NT.2 types, whether susceptible or resistant, have proved themselves over a period of years to be inferior to Domains Sakel in quality and in earliness. In quality NT.2 lies between the X.1730 range (the "L" cottons) and Domains Sakel (the "S" cottons). Such an intermediate is neither desired by the Sudan Plantations Syndicate nor considered by the members of the Plant Breeding Section to merit further genetic work. For these reasons all work on NT.2 at Shambat has ceased.

3. Blackarm-resistant X.1730.—As an insurance lest BAR.4/11 should prove unsuitable, a small area of ninth backcross X.1730, homozygous for both B_2 and B_3, was propagated at Shambat. In addition, a small plot of B_1B_3 1730 was grown as a stage in the synthesis of a type carrying all three of the resistance genes.

BAR.1730L has now been on trial in the Gezira for four seasons and this should be adequate as a measure of its success or failure. BAR.1730L, which carries B_2, was derived from the seventh backcross of Uganda B.31 by varieties of the X.1530–X.1730 group (the last four backcrosses were all onto X.1730 strains and the first four crosses were all onto X.1530 strains).

Spinning tests are not as yet available for all four seasons but a fair picture can be obtained by examination of the first three years' results. These are given below :—

Spinning Test Comparison of BAR.1730L (carrying B_2) with X.1730A.

Variety test. Site and Season.	*BAR. 1730L.*					*X.1730A.*				
	Effective length 32nds.	*Hair Wt.*	*Lea tests : Count × strength.*			*Effective length 32nds.*	*Hair Wt.*	*Lea tests : Count × strength*		
			80's	*100's.*	*120's.*			*80's.*	*100's.*	*120's.*
G.R.F. 1942–3	47	148	2,364	2,022	1,711	48	159	2,318	2,101	1,737
Barakat 1942–3	47	150	2,125	1,919	1,624	47	157	2,222	1,901	1,702
Barakat 1943–4	47	164	2,214	1,923	1,685	48	155	2,214	1,905	1,619
Hag Abdalla 1943–4 ...	48	149	2,320	2,016	1,620	49	149	2,363	2,157	1,750
Azrag 1943–4	50	162	2,353	2,040	1,771	50	166	2,326	2,044	1,812
G.R.F. 1944–5	49	156	2,351	2,020	1,888	50	161	2,360	2,076	1,876
Barakat 1944–5	48	163	2,257	2,012	1,795	47	162	2,321	1,987	1,761
Hag Abdalla 1944–5 ...	49	156	2,307	2,150	1,820	49	165	2,271	2,010	1,765
Abu Wafi 1944–5... ...	49	163	2,282	2,051	1,798	51	161	2,361	2,062	1,857
Averages	48·2	156·8	2,286	2,017	1,746	48·8	159·4	2,306	2,027	1,764
Averages (all counts) ...	—	—	—	2,016	—	—	—	—	2,032	—

These figures show a difference in length of approximately 1/64th inch between the two strains, X.1730A being the longer. The hair weight difference of 2·6 is in favour of BAR.1730L. In the lea tests, X.1730A showed an increase of 0·9% at 80's, 0·5% at 100's and 1·0% at 120's. Clearly both strains are, for all practical purposes, identical as regards effective length, hair weight and strength. Thus the gene B_2 has been successfully transferred from American Upland to X.1730 without affecting the lint quality.

Turning now to yield differences : seventeen comparisons of BAR.1730L with X.1730A, spread over a period of four years are available. These figures are given below :

Comparison of Lint Yields of BAR.1730L and X.1730A in a Series of Seventeen Variety Tests.

Variety Test, Site and Season.	*Yield in lb. per acre.*	
	BAR.1730L	*X.1730A.*
G.R.F. 1942–3	577	618
G.R.F. (Subsidiary) 1942–3	754	707
Turabi, 1942–3	624	615
Barakat 1942–3	715	785
Azrag, 1943–4	369	368
Abu Wafi, 1943–4	412	405
G.R.F., 1943–4	585	535
Barakat, 1943–4	753	678
Hag Abdalla, 1943–4	541	503
Azrag, 1944–5	477	482
Abu Wafi, 1944–5	414	428
G.R.F., 1944–5	720	736
Barakat, 1944–5	424	450
Hag Abdalla, 1944–5	829	831
Kab el Gidad, 1945–6	318	314
G.R.F., 1945–6	384	386
Hag Abdalla, 1945–6	356	389
Totals	9,252	9,230
Averages	544	543

Obviously, under the conditions of trial, there is no difference in lint yield between these two strains. In this connection the nature of these conditions of trial should be borne in mind.

In the first place, blackarm is, as far as possible, excluded from the Gezira area. All seed is treated with mercuric dusts; this applies both to commercial seed and to that for variety tests. At the end of each season the plants are pulled up, over the whole 200,000 acres, and burnt. The land is then swept and the plant debris from the pulled-up cotton crop is burnt. Finally, to avoid blackarm, the crop is sown considerably later than would be considered desirable by the Syndicate, in the absence of blackarm.

Thus, under conditions in which every effort has been made to exclude blackarm, BAR.1730L and X.1730A have shown themselves equal in lint yield and in spinning quality. Moreover, in the first season's tests, BAR.1730L seed was of Shambat origin whereas the X.1730A supply came from the Gash. Shambat seed is notoriously inferior to Gash seed because of bollworm damage and "pinched" grains. In the second, third and fourth seasons the BAR.1730L seed was of Gezira origin whereas the X.1730A control seed was from the Gash. Although the difference between Gezira seed and Gash seed is not as great as that between Shambat and the Gash, it is nevertheless widely acknowledged that Gash seed is superior.

In view of this established equality of BAR.1730L and X.1730A over a four-year period under existing conditions of blackarm control, it is considered that the time has come to try BAR.1730L on a commercial scale, sowing it earlier than is possible with the present susceptible main crop of X.1730A. The earlier sowing (made possible by the presence of blackarm resistance) would allow a longer growing and fruiting period and would also, it is considered, improve grade. Incidentally, a greater range in permissible sowing date would greatly improve the labour situation in the Gezira.

4. *Transference of Blackarm immunity from* G. sanguineum* *(n=13) to Sakel (n=26) types.*—The blackarm immunity of *sanguineum* has been shown to depend on two genes and the genetics of resistance in *G. arboreum* is being written up for publication as part VI of "The Genetics of Blackarm Resistance" series. The weaker of these two factors was successfully taken to the sixth Sakel backcross stage and seed of seventh backcross composition was produced for sowing next season. The stronger factor was lost from the cross-bred material, before crosses within *G. arboreum* proved the presence of two genes. In consequence, early backcross material is being sown again in the hope of recovering the stronger resistance gene.

5. *Flagging blackarm-resistant X.1730 with the arboreum gene for red flowers and leaves.*—This is being carried on as a routine process. The end-product will be tested eventually against the end-product of the straight blackarm-resistant X.1730 breeding programme.

Production of blackarm-resistant strains of American Upland for the Southern Sudan.

1. *Blackarm-resistant Uganda SP.84.*—With the acceptance of BAR.SP.84 as the future commercial cotton for Kordofan and Equatoria

* *G. arboreum* L. race *bengalense* (Silow).

provinces, all transference work with other Upland varieties has ceased, except for the transference of B_2 and B_3 to Uganda BP.52.

In order to speed-up the seed supply of BAR.SP.84 in Kordofan Province a 3½-acre propagation plot was sown at Shambat in 1945–6 winter. This yielded 732 lb. of seed cotton per acre. Bollworm infestation was light, probably because the area was sprayed with a 0·1% emulsion of D.D.T. The seed from this plot will go to a propagation area on the Abu Habl Scheme near Rahad, in Kordofan, in 1946 summer.

The synthesis of a strain of BAR.SP.84 carrying both B_2 and B_3 was continued and seed was obtained out-of-season for sowing a small propagation plot of this type next year.

2. *Blackarm-resistant Uganda BP.52.*—In transferring B_2 from NT.61/38 to BP.52, fifth backcross progenies were grown in-season and F_2s of these were grown in 1945–6 winter. Seed from homozygous plants in these F_2s will sow a bulk propagation plot, pure breeding for blackarm-resistance, next season.

A small propagation plot of homozygous material, derived from the third backcross, was grown and a small quantity of seed from this has been sent to Kawanda, Uganda, as being of possible use in their breeding plot.

Pink Bollworm (Platyedra gossypiella) *Resistance.*

1. *Gossypium thurberi* crosses.—Six F_1 seeds of Sakel × *G. thurberi* were soaked in 0·5% colchicine for 48 hours. All six seeds gave rise to hexaploid plants which, for convenience, have been called *G. "thurbadense."* Like *thurberi*, *G. thurbadense* also shows resistance to pink bollworm. Crosses were made between *thurbadense* and Domains Sakel and F_1 plants were raised in 1945–6 winter. These were remarkably uniform and were all presumably 65 chromosome types carrying a full *barbadense* somatic complement plus a single set of *thurberi* chromosomes. There was no sign of pink bollworm resistance in these families so, presumably, the resistance of *thurberi* is recessive. These families have been successfully backcrossed to Sakel and the seed of these backcrosses will be sown next season.

2. *G. armourianum* crosses.—The hexaploid *G. armadense*, was successfully crossed with Sakel and the F_1 families were sown in 1945–6 winter. These progenies were not as uniform as the comparable *G. thurbadense* hybrids. This indicates a stronger residual homology between the *armourianum* genom and the "D" genom of Sakel than between *thurberi* and the "D" chromosomes in Sakel. They were successfully backcrossed to Sakel and the backcross progenies will be grown next season.

Jassid Resistance.

In this work the objective is to transfer major genes for hairiness, from a range of types, to Sakel and then to test their efficacy in various combinations. The economic background of these transferences is the fact that spraying with insecticides has demonstrated that yield, in

the northern Gezira, can be increased by a third of a kantar to one kantar (312 lb.) of seed cotton by the partial elimination of insects—mainly jassids.

Spinning tests of NT.2 × Tanguis crosses show a higher hair weight, but no loss of strength, in material carrying the Tanguis hairiness gene H_1. The H_1 gene is now being re-transferred from NT.2 to Domains Sakel and this work reached the fifth backcross stage in 1945–6 winter and sixth backcross seed has been obtained for sowing next season.

An *arboreum* hairiness gene, designated H_3, has been taken out of *G. sanguineum* and this transference reached the sixth backcross in the out-of-season plots. The relationship between H_1 and H_3 will be investigated next season.

The transference of a hairiness gene from Carpulla (a *barbadense* type) to Domains Sakel reached the fifth backcross stage.

Transferences from *G. tomentosum*, St. Ignatius, MU.8b, Ferguson and Kapas Purao are in their first backcross stage.

Ginning Outturn Investigation.

Since this work was designed to raise the G.O.T. of XA.129 and since XA.129 has been superseded by BAR.SP.84, this investigation has been discontinued.

Other Investigations.

1. *Deciduous bractlet.*—Clearly a Sakel type which shed its bracteoles before picking time would be a great advantage, hence an attempt has been started to transfer this deciduous character from an Upland variety (supplied by Dr. Silow) to Domains Sakel.

2. *Mechanical picking.*—Since it is possible that mechanical picking may one day prove desirable in the Gezira the transference of the two characters " Egyptian Short Branch " and " Cluster " is being attempted. The former character is being transferred from an Egyptian type and the latter from an Upland variety. This work was initiated at Mr. Hutchinson's suggestion.

3. *The genetic nature of the blackarm immunity of* G. anomalum.—*G. anomalum* (nearly immune) has been successfully crossed with a fully susceptible *arboreum* type from Java and first backcross (to Java) seed has been obtained for sowing next season.

Blackarm-resistance survey of Wild Cottons.

Preliminary lists were given in my 1942–3 and 1944–5 reports (pp. 72 and 57, respectively). The following additional types have now been examined :—

G. sturtii : susceptible.
G. davidsonii var. klotzschianum : resistant.
G. somalense : resistant (3 accessions).
G. barbadense var. darwinii :* susceptible (3 accessions).

* In my 1942 Report *G. darwinii* was recorded as resistant but this record was made on an accession, received from abroad, which was subsequently identified as G. *hirsutum var. punctatum.*

Permanent Wild Cotton Garden.

The collection previously being grown at Shambat has been combined with Mr. Hutchinson's collection from Trinidad and the following types are now growing satisfactorily: *G. anomalum* (3 accessions), *G. somalense* (3 accessions), *G. stocksii* (2 accessions), *G. sturtii*, *G. thurberi* (2 accessions), *G. armourianum*, *G. harknessii*, *G. davidsonii*, *G. davidsonii var. klotzschianum* (2 accessions), *G. raimondii* (2 accessions), *G. aridum* and *G. tomentosum*.

During the year *G. anomalum* was collected from Gebel Merkhiyat near Omdurman, and from Fertangul, 20 miles south of El Obeid. *G. somalense* was recorded, for the first time in the Sudan, at Gebel Merkhiyat and plants and seeds were collected.

Cotton Type Collection from Trinidad.

Nearly all the type in this collection have now been established and have yielded adequate quantities of seed.

Diseases and Pests.

Blackarm (*Bact. malvacearum*) was, as usual, general.

Leaf Curl, except for isolated cases, was less severe than usual.

Pink bollworm (*Platyedra gossypiella*) was severe and general though plots sprayed with D.D.T. emulsion showed a much lighter attack. In this connection it should be noted that D.D.T. *suspension* (in water), unlike the emulsion, causes marked distortion and fasciation of growing cotton plants even at concentrations as low as 0·1%. In such plants the flowers become sympetalous, narrow, tubular structures and there is a more or less complete suppression of the leaf lamina, so that the veins run parallel, making the leaves into strap-like structures with tendril-like points at the end representing the leaf lobes.

Publications.

Knight, R. L. "Dictionary of Genetics." *Chronica Botanica Vol. 12 No. 1 c.* $2·50 (in press).

Knight, R. L. The Genetics of Blackarm Resistance. V. Dwarf-bunched and its relationship to B_1. *J. Genet. 1946. 48. 1. pp. . . . . .(in press).*

Knight, R. L. Breeding Cotton Resistant to Blackarm Disease (*Bact. malvacearum*). I & II. *Emp. J. Exp. Agric. 1946. 14. pp. 153–160, & 161–174.*

Summary and Conclusions.

The transference of blackarm resistance from synthetic NT.2 types to Domains Sakel reached the fifth backcross, and sixth backcross seed was produced for sowing next season. Further backcrossing is unlikely to be necessary.

Data are presented showing BAR.1730L (seventh backcross derivitive carrying B_2) to be equal to X.1730A in spinning quality and in yield. The figures on which these conclusions as to spinning quality are based were derived from nine variety tests in the Gezira spread over three years. Lint yields of BAR.1730L and X.1730A are identical when averaged over the seventeen Gezira variety tests grown in the past four years. It should be noted that in these variety tests (as in the commercial cotton in the Gezira) every effort has been made to exclude blackarm. It is suggested that BAR.1730L might profitably be grown on a commerical scale, sowing it earlier than is usual with X.1730A, in order to benefit from its blackarm resistance. Advantages would be : increased growing and fruiting period, better grade, and better distribution of agricultural labour.

On the "American" side, BAR.SP.84 has been accepted as the commercial type for Kordofan and Equatoria provinces.

PROGRAMME FOR 1946-1947.

In the transference of the blackarm resistance genes B_1, B_2 and B_3 from NT.2 strains to Domains Sakel, sixth backcross progenies carrying these individual genes will be sown. These will be selfed to produce homozygous lines from which a type carrying all three genes can be integrated.

On the X.1730 side the integration of a type carrying all three resistance genes will be completed and the transference of the Asiatic factor for red coloration will be completed using this type as the final parent.

The transference of blackarm resistance from *G. arboreum* to Sakel will be continued and a large F_1 of tetraploid *G. herbaceum* ♀ × Sakel ♂ will be grown as a first step in starting transferences from *herbaceum* to Sakel.

The transference to Domains Sakel of a range of hairiness genes from diverse cotton varieties will be continued with the ultimate object of building up jassid resistance.

Backcrossing of G. "*armadense*" and G. "*thurbadense*" to Sakel with a view to transferring pink bollworm resistance will be carried on.

On the American side 5th backcross material of BP.52 type, carrying B_2, will be bulked for trial and an SP.84 type will be integrated carrying both B_2 and B_3. The transference of B_3 to BP.52 will continue.

KADUGLI STATION.

BY

M. F. ROSE.

Introduction.

This season, the Kadugli Station was, up to November, 1945, ably supervised by the Senior Sudanese Technical Assistant of the Plant Breeding Section (Hassan Effendi Osman El Nur) with long range control by Mr. Anson from the Gezira Research Farm. On the 9th November, 1945, Mr. M. F. Rose, formerly of the Barberton Station, took charge as Senior Plant Breeder. On his arrival in the Nuba Mountains he was fortunately able to tour the cotton-growing areas of the Eastern and Western Gebels (hills) in the company of Messrs. Anson and Hutchinson and of Mr. Lord of the Shirley Institute.

Meteorology.

The following table compares the 1945 rainfall (in mm.) with the average monthly precipitation for the 36 years 1910–1945.

Period.	*Jan.*	*Feb.*	*March*	*April*	*May.*	*June.*	*July.*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total.*
1945 ...	—	—	—	—	165·0	65·9	187·7	142·3	80·6	17·0	—	—	658·5
1910–1945	—	1·6	1·3	14·3	77·6	123·9	153·3	153·9	138·3	81·0	5·7	—	750·9

The October total of 17 mm. was the lowest on record. From the above table it will be seen that the total precipitation was approximately 100 mm. below average and that for June—the best month for sowing—was only about half the average. The range of maximum temperatures was 38·2—23·6°C. (mean 32·7°C. or 90·9°F.) for the wet season (June—October); and 38·7—27·8°C. (mean 35·7°C. or 96·3°F.) for the dry season (November and December). For the same periods the range of minimum temperatures was 26·2—15·2°C. (mean 21·4°C. or 70·5°F.) and 23·4—14·2°C. (mean 18·3°C. or 64·9°F.), respectively.

Inherent Agricultural Circumstances.

The season witnessed a further reduction in the cotton acreage sown. The decline was from 10,000 acres, in the previous season, to barely 4,400 acres. This reduction in acreage can be ascribed directly to the dura (sorghum) crop, which as a cash crop is becoming, more and more, a serious rival to cotton.

Intensive propaganda to increase the dura area and a high guaranteed Government price for the grain, made the cultivators acutely aware of the enhanced value of this crop and its present greater cash return per acre. As a result, cotton was sadly neglected and as the season's low and badly distributed rainfall favoured the " early " and " medium " maturing dura types more than it did cotton, the cultivators are now very " dura minded " and cotton prospects in the Nuba Mountains are at a low level.

The cultivators would not chance sowing with the heavy rains in May and as the June precipitation was ineffective the bulk of the crop was sown in late July and early August, although it has been proved, demonstrated and repeatedly emphasised that with normally distributed rainfall the June sowings will always give higher yields and better grades than later sowings. This late sowing, the low and badly distributed rainfall and the general neglect of the crop were mainly responsible for the very low yields obtained. Late types, sown in July, gave practically no yield as instanced at Gannaya where 25 acres of NT.209/41 gave an average yield of only 16 pounds of seed-cotton per acre. In contrast the twenty acres of the early-maturing BAR.NT.205/43 variety, sown at Miri on 7th August, yielded 300 pounds of seed-cotton per acre on a total precipitation of only 193·2 mm. The present season offers the strongest argument in favour of sowing only early-maturing varieties.

Cotton Breeding and Selection Work.

Twenty-seven progenies, made up of thirteen selections from NT.205/45 and fourteen from B.181 (ex Uganda), together with eight new introductions from Nyasaland, were studied in the breeding plot this season. The NT.205/45 progenies gave excellent all-round results and eight of the most uniform, for type and desirable characters, will be bulked to form a new nucleus for multiplication.

After analysis, the B.181 progenies were all discarded in spite of their fineness, good length and " feel " as their ginning outturns were very low (28·6%) compared with the mean ginning outturn of 36·4% obtained from sixty-three BAR.NT.205/43 progenies which are being carried forward next season.

In the Nyasaland material, grown for the first time, five of the eight strains (Mz. 561, T–1, T–3, CL 20–4 and CL 46) had good all-round characters. The plants were neat, compact and hairy and, although the yield of seed-cotton per plant was slightly below average, thirteen single plant selections are to be grown next season. The mean character values of these new introductions are :—*Lint length*—37·8 mm. ; *Lint quality*—strong but not coarse ; *Seed Weight* (100)—10·9 gm. ; *Lint Index*—5·0 gm. ; *G.O.T.*—31·6%.

Cotton Variety Trials.

Two variety trials were sown at Kamina Farm (Kadugli) on 30th June, and one in the Talodi area on 22nd July, 1945. Following are the results :—

Lint Yields (in lb. per acre) of the Main Trial at Kamina Farm.

	BAR. S.P.84	*P.S.S. (Control).*	*BAR.NT.205/43.*	*NT.58/43.*
Lint (lb. p.a.)	324	292	272	227
% of P.S.S.	111	100	93	78
S/C (lb. p.a.)	980	1,008	847	754
G.O.T. (%)	33·1	29·0	32·3	30·1

Lint yield differences were highly significant at the 0·1% level and a significant difference was 23 pounds of lint per acre. BAR.SP.84 out-yielded Pump Scheme Strain (P.S.S.) by 11% and the other varieties by 18% and 33% respectively and these differences were highly significant.

LINT YIELDS (IN LB. PER ACRE) OF THE MISCELLANEOUS TRIAL AT KAMINA FARM.

	NT.209/41.	*P.S.S. (Control)*	*NT.206/41.*	*NT.201/41.*
Lint (lb. p.a.)	302	271	242	185
% of P.S.S.	111	100	89	68
S/C (lb. p.a.)	907	938	804	685
G.O.T. %	33·3	28·9	30·0	27·0

Lint yield differences were highly significant at the 0·1% level and a significant difference was 22 pounds of lint per acre. NT.209/41 out-yielded the control (P.S.S.) by 11% and the other varieties by 22% and 43% respectively and these differences were highly significant.

LINT YIELDS (IN LB. PER ACRE) OF THE TRIAL AT TALODI.

	BAR.SP.84.	*NT.209/41.*	*P.S.S. (Control).*	*BAR.NT.205/43.*	*NT.58/43.*
Lint (lb. p.a.) ...	200	182	171	165	110
% of P.S.S.	117	106	100	96	64
S/C (lb. p.a.)	616	541	603	511	378
G.O.T. (%)	32·5	33·6	28·3	32·3	29·0

Lint yield differences were highly significant at the 0·1% level and a significant difference was 21 pounds of lint per acre. BAR.SP.84 significantly out-yielded the control (P.S.S.) but not NT.209/41. It out-yielded the other varieties by 21% and 53% respectively and these differences were highly significant.

To sum up, BAR.SP.84 has, in the above trials, significantly out-yielded the Pump Scheme Strain control. It is one of the earliest maturing varieties on the Kordofan and is blackarm resistant. In general performance, under variable climatic conditions, it is superior in yield to the other varieties against which it has been tested. Brokers reports on the samples from 1944–45 Kadugli and Talodi Trials show an average value of 14·30 pence for BAR.SP.84 as against 13·98 pence for P.S.S. On the other hand the spinning tests for these samples show BAR.SP.84 to have a somewhat higher hair weight and to be rather weaker than P.S.S.

PROPAGATION.

Isolated areas of the more important varieties were grown to obtain pure seed, but yields were, in general, poor.

Following are the data :—

Variety.	*Site.*	*Date Sown.*	*Acreage.*	*Mean S/c yield (lb. per acre).*	*Type of Supervision.*
BAR.NT.205/43 ...	Miri	6/8/45	100	158	Cultivators
BAR.NT.205/43 ...	Miri	6/8/45	20	300	Technical Staff
BAR.SP.84 ...	Dam Gamad	28/7/45	60	124	Cultivators
NT.58/43 ...	Berdab	28/7/45	12	160	Cultivators
NT.96/40 ...	Mek's	30/6/45	6	314	Technical Staff
NT.206/41 ...	Talodi	22/7/45	5	334	Technical Staff
NT.209/41 ...	Gannaya	5/8/45	25	16	Cultivators
All types (Obs. and Expt.)	Kamina Farm	30/6/45	12	780	Technical Staff

The above demonstrates the importance of early sowing with normal rains and the necessity for adequate supervision and care of the crop to ensure remunerative yields and make it a successful competitor with the dura crop.

Cotton Diseases and Pests.

Blackarm Disease (B. malvacearum) : This disease appeared at the beginning of August but caused little damage except on Pump Scheme Strain which had the highest infection.

Flea-beetle (Podagrica puncticollis) : At Kamina Farm this pest attacked the young plants but caused little damage. In outlying commercial areas, however, its incidence rose to serious proportions and severe damage was caused especially to late-sown areas.

Leaf Roller (Sylepta derogata) : This was a serious pest on Kamina Farm and throughout the area until end-September. It was partly controlled by hand-picking.

Cotton Stainers (Dysdercus spp.) : These appeared at Kamina Farm in early October, although elsewhere in the area their population had reached its peak at end-August. The Experimental Farm was sampled for stainer population on 26th November and gave the following population per acre : *D. fasciatus*—306 : *D. superstitiosus*—189 : No other species was observed. The percentage of lint-staining in open bolls was : October—0·2%, November and December—0·3%, or well below the general average for the area.

Bollworms : At Kamina Farm samples of green bolls were analysed for percentage infestation, at fortnightly intervals, from 3rd October. The results follow :—

Type of Bollworm.	*Oct.* (%).	*Nov.* (%).	*Dec.* (%).
Pink (*Platyedra gossypiella*)	2·0	12·5	11·2
Egyptian (*Earias insulana*)...	2·2	4·3	9·4
Sudan (*Diparopsis castanea*)	0·8	0·9	1·4

Figures for damage from American Bollworm *Heliothis armigera* are not available as no sampling was done end-August to September, *i.e.* during the budding and flowering phase of the crop. Doubtless, however, this pest did cause some loss as it is ever-present in Kordofan.

Jassid (Empoasca benedettei) : This pest, though present throughout the crop, caused no damage. The length and density of leaf hairs is being maintained on the varieties now grown and this should safeguard them from severe jassid damage.

PROGRAMME FOR 1946-47.

Sixty-three selections from NT.205/45, and thirteen from Nyasaland types will be observed in progeny rows.

Five hundred primary selections from BAR.SP.84 will be grown for filtering.

Variety trials comparing BAR.SP.84, Pump Scheme Strain (Control), NT.96/40, NT.205/42, BAR.NT.205/43 and NT.209/41 will be carried out at Kamina Farm and Talodi.

The following improved strains will be bulked :—

(*a*) 500 acres of BAR.SP.84 situated on the Abu Habl Scheme under controlled flooding.

(*b*) 200 acres of BAR.NT.205/43 belted with 500 acres of the same variety at Berdab.

(*c*) ½ acre of NT.205/45 at Kadugli Farm.

Other Crops.

Hickory King maize and tomato strains (T9, T10 and Special) will be bulked for seed.

EQUATORIA PROVINCE.

Inherent Agricultural Circumstances.

The inherent agricultural circumstances have already been given in detail for Equatoria Province on pp. 75–77 of the 1943/44 Progress Report.

Meteorology.

The season's rainfall (in mm.) at Meridi was as follows :—March, 33·0 ; April, 142·0 ; May 201·0 June, 177·1 ; July, 233·7 ; August, 227·7 ; September, 182·0 ; October, 105·0 ; November, 31·3 ; December, 16·2.

At Kagelu the rainfall (in mm.) was as follows : April, 24th–30th, 49·5 ; May, 154·2 ; June, 200·7 ; July, 155·5 ; August, 181·5 ; September, 253·5 ; October, 85·9 ; November, 41·8 ; December 1st–13th, 22·1 mm.

The season was good and yields were slightly above average.

Cotton Variety Trials.

Two trials were sown at Meridi on 5th May and one at Kalegu on 24th April, 1945. The latter was entirely supervised by Mr. Ferguson —the Inspector of Agriculture in charge of this area. The results follow :—

The Results of the Trial at Meridi—Site 1.

	BAR.SP.84.	*BAR.NT.205/43.*	*511D (Control).*	*NT.201/42.*
Lint (lb. p.a.)	381	366	346	261
% of 511 D	110	106	100	75
S/C (lb. p.a.)	1,112	1,046	1,050	921
% of 511 D	106	100	100	88
G.O.T. (%)	34·3	35·2	32·9	28·4

Lint yield differences were highly significant at the 0·1% level and a significant difference was 47·5 pounds of lint per acre. The first three varieties did not differ significantly, but were significantly higher than NT.201/42. Seed cotton yield differences were not significant.

THE RESULTS OF THE TRIAL AT MERIDI—SITE 2.

	BAR.SP.84.	*511D (Control).*	*BAR.NT.205/43.*	*NT.201/41.*
Lint (lb. p.a.)	364	342	331	253
% of 511 D	106	100	96	74
S/C (lb. p.a.)	1,035	1,021	925	884
% of 511 D	101	100	91	87
G.O.T. (%)	35·1	33·4	35·4	28·6

Lint yield differences were highly significant at the 0·1% level and a significant difference was 24·8 pounds of lint per acre. Thus BAR.SP.84, although not differing from the control, significantly out-yielded the other two varieties. Seed cotton yield differences were also highly significant at the 0·1% level and a significant difference was 68·0 pounds of seed cotton per acre. Again BAR.SP.84 although not differing from the control, significantly out-yielded BAR.NT.205/43 and NT.201/41.

SEED COTTON YIELDS (LB. P.A.) OF THE TRIAL AT KAGELU.

	BAR.SP.84.	*BAR.11/2.*	*511 D (Control).*	*BAR.NT.205/43.*
S/C (lb. p.a.)	894	884	731	700
% of 511 D	122	121	100	96

Seed cotton yield differences were highly significant at the 0·1% level and a significant difference was 68 pounds of seed cotton per acre. Thus BAR.SP.84 and BAR.11/2, which did not differ, significantly out-yielded the 511 D control and BAR.NT.205/43.

SUMMARY.

In all three trials BAR.SP.84 gave the highest seed cotton and lint yields and in the first two trials its mean ginning outturn was 34·7% as compared with that of 511D at 33·2%. It is being bulked up to replace 511D.

PROPAGATION.

At Yambio, four isolated areas of BAR.SP.84 were grown for seed and yielded 40,430 lb. of seed-cotton or (with a G.O.T. of 34·7%) $11\frac{3}{4}$ tons of seed. This seed will be returned to Yambio for distribution to cultivators.

PESTS AND DISEASES.

Records on pest and disease damage were made only at Meridi, using the one to seven scale of intensity of damage. From these data the following conclusions are drawn :—

Cotton Stainers.—Medium numbers in August ; very increased population in September ; reached their peak in October and started falling off in November.

Lygus sp.—Medium in August ; slight to medium in September.

Jassid sp.—Slight in August ; slight to medium in September.

Egyptian Bollworm.—Slight in August, very slight in September.

Pink Bollworm.—Medium in August ; slight in September.

Sylepta sp.—Slight in November.

Blackarm disease.—Medium in September.

Ramularia disease.—Slight in September.

PROGRAMME FOR 1946-47.

Cotton varieties BAR.SP.84, MU.8b, Congo Triumph and local Kajo Kaji cotton will be tested in varietal tests at Meridi and Yambio.

The BAR.SP.84 seed bulked at Yambio will be distributed to peasants for planting on a commercial scale.

APPENDIX.

Key to Symbols Used in This Report.

Varieties.

511D.	From Uganda SG.85, single plant selection.
B.31.	A blackarm resistant Upland type from Uganda.
B.181.	A direct import from Uganda.
BAR.NT2/41.	An NT.2 strain homozygous for B_2
BAR.NT205/43.	Selected from Uganda SP.20 and homozygous for B_2
BAR.SP.84.	The blackarm resistant component of Uganda SP.84R.
BAR.4/5.	9th backcross X.1730 homozygous for B_2
BAR.4/11.	X.1730 carrying both B_2 and B_3
BAR.11/2.	3rd backcross of XA.129 type carrying B_2 transferred from NT.61/38.
BAR.1730L.	7th backcross X.1730A homozygous for B_2
BAR.1730L. Selection 1 :	BAR.1730L which has been " filtered."
BAR.1730L. Selection 2 :	BAR.1730L which has been " filtered."
BP.52.	A direct import from Uganda.
Congo Triumph.	A direct import from the Belgian Congo.
Deltapine.	Foster × Express from Delta and Pine Land Co., bulk selections.
Domains Sakel.	A standard variety originally imported from Egypt.
Dom.Sak.	A standard variety originally imported from Egypt.
D.S.	A standard variety originally imported from Egypt.
Domains Sakel Selection 1.	Domains Sakel which has been " filtered."
Domains Sakel Selection 2.	Domains Sakel which has been " filtered."
Ferguson.	A hairy Upland obtained from the Phillipines via Trinidad.
JR.9/3.	2nd backcross NT.2 homozygous for H_1 from Tanguis.
JR.9/4.	3rd backcross NT.2 homozygous for H_1 from Tanguis.
JR.9/7.	6th backcross NT.2 homozygous for H_1 from Tanguis.
Kajo Kaji Cotton.	A local cotton from Equatoria.
Kapas Purao.	A hairy Upland Phillipine type.
" L " Cotton.	The X.1530–X.1730 group of cottons.
Massey's Domains Sakel M.D.S.	A Sakel variety selected by R. E. Massey.
M.U.8b.	A hairy Upland from India.
NT.2.	A selection from Sakel resistant to leaf curl.
NT.2/39.	A reselection from the NT.2 stock.
NT.58/39.	A selection from a " Punjab Early " outcross.
NT.58/42.	A later selection of the same type as NT.58/39.
NT.58/43.	A later selection of the same type as NT.58/39.

Varieties.

NT.61/38.	A Pump Scheme type carrying B_2 transferred from B.31.
NT.96/40.	57 × " Over-the-top," a single plant selection.
NT.201/41.	A selection from Uganda SP.20.
NT.205/41.	A selection from Uganda SP.20.
NT.205/42 NT.205/45.	Successor types to NT.205/41, above.
NT.206/41.	A single plant selection from Uganda SP.84.
NT.209/41.	From (U4 × Cambodia) × U4.
Pump Scheme Strain.	Commercial type which originated from Nyasaland Upland.
" S " Cotton.	Domains Sakel.
SFD.–5.	A variety of Domains Sakel originally imported from Egypt.
SP.84.	A direct import from Uganda.
St. Ignatius.	A variety of Marie-Galante.
Tanguis.	A *barbadense* type imported from Peru.
X.1530.	A bushy variety selected by A. R. Lambert from Sakel.
X.1530A.	A successor type to X.1530.
X.1530 Hairy.	A hairy selection found in X.1530 by H. E. King.
X.1730.	A bushy variety selected by A. R. Lambert from Sakel.
X.1730A.	The successor type to X.1730 at present grown commercially.
X.A.129.	From a single plant selection from Pump Scheme Strain.

Genes.

B_1	A dominant weak blackarm resistance factor from Uganda B.31.
B_2	A dominant strong blackarm resistance factor from Uganda B.31.
B_3	A strong partially, dominant blackarm resistance factor from *G. punctatum*.
H_1	A hairiness gene from Tanguis.
H_3	A hairiness gene from *arboreum*.

[*Included by courtesy of the Uganda Government.*]

UGANDA.

COTTON EXPERIMENT STATIONS, KAWANDA AND SERERE, PROGRESS REPORTS FOR THE SEASON 1945-46.

KAWANDA AREA.

BY

J. D. JAMESON
Senior Botanist.

Introduction.

Native Agricultural System.[1]—In the 1943–44 report it was stated that there are few cattle owing to worry by the biting fly *Stomoxys* and that manure plays no part in the system. During the past two or three years there has been a rapid increase in the amount of cash in in the hands of the urban population. This has caused a rapid increase in the demand for meat and milk and prices have risen steeply. Farmers in elephant grass areas close to the main consuming centres have responded to this rise by building sheds in which cattle are kept during the day time. In most cases smudge fires are kept burning and in some cases cows and calves are being fed with cut elephant grass, banana peelings and cotton seed. Under these conditions cattle do well in areas where *Stomoxys* had previously made cattle keeping uneconomic. These conditions have also made manure utilization feasible and a few farmers now apply dung to their banana gardens and coffee. In the north of Buganda trypanosomiasis has spread into a number of new areas and the few cattle which were kept there in the past have died or been slaughtered.

Meteorology.

	Rainfall at Kawanda (inches).		*Planting.*	*Harvesting.*
	1945.	*Mean. 1936-44.*		
January	2·63	2·10	—	Cotton
February	2·84	2·63	—	Cotton
March	6·01	4·16	Food	—
April	1·14	7·05	Food	—
May	8·12	5·16	Food	—
June	1·05	2·61	Cotton	Food
July	1·59	2·06	Cotton	Food
August	6·11	3·23	Food and Cotton	—
September	4·01	4·19	Food	—
October	1·77	3·91	—	—
November	4·41	4·79	—	Food
December	1·01	3·77	—	Food and Cotton
Total	40·69	45·66		

(1) Paragraph contributed by Mr. R. K. Kerkham.

In March there were two breaks of very heavy rain and planting opportunities were few. The first break rapidly made the land too wet to work on and the second unfortunately coincided with the Easter holidays, so not all the food crops were established in good time. The main rains in April are usually reliable both in time and quantity and their failure this season is without precedent in the recollection of most people now in Uganda. Cotton planting was not directly disturbed by these earlier vagaries in the weather ; but the delay to some of the food crops was unfortunate, because on some fields the time left was not sufficient to raise a second crop later in the year. There was a further five-week drought from mid-September to late October. This coincided with the onset of flowering on July-planted cotton and was especially interesting, because it did not cause an undue amount of shedding. The cotton harvesting period from December to February was ideal, being dry and sunny throughout.

Conclusions from Work Done in 1945-46.

Agriculture.

A programme of husbandry research which provides fully for work to be done in Buganda has recently been prepared. Some of this work is, of course, already progressing at Kawanda, Bukalasa and elsewhere, but it will be some time before results emerge. Meanwhile there will be no further references to such subjects as rotations and interplanting in this report.

Sowing Date.—No cotton was planted on Kawanda farm until 27th June. This action was taken on Taylor's[1] statement that : " In the elephant-grass zone much of the *Lygus* damage would be avoided if sowing began in June instead of May." Taylor's prognosis was amply fulfilled and there was comparatively little *Lygus* damage ; although it must be allowed that the unusual drought in April may have disturbed the ordinary sequence of the events. The features of the crop were :—

(*a*) a large crop was set from the main flowering flush in spite of the drought in September–October, *i.e.* drought without *Lygus* did not cause shedding of the main crop.

(*b*) apart from a rather sharp attack of *B. malvacearum* in August–September the crop was remarkably free from diseases and pests of all kinds.

(*c*) picking lasted for two months only, from December to February, and picking costs were very greatly reduced.

(*d*) The amount of stained cotton was negligible ; good harvesting weather contributed to this result, but it is fairly certain that the healthy life of the crop was the main cause.

(*e*) yields were remarkably level from all fields over a sowing date range from late June to early August.

(1) Taylor, T. H. C. (1945), *Bull. Ent. Res.*, 36, 146.

The last point is illustrated by the following table, summarizing the yields of *clean* seed cotton in pounds per acre from the Kawanda 20-acre increase area for the past five seasons :—

Sowing Date.	April	May.	June.	July.	August.	All.
1941...	—	724 (6)	759 (1)	—	—	730
1942...	—	969 (2)	931 (4)	724 (1)	—	926
1943...	—	542 (2)	504 (3)	371 (2)	—	498
1944...	177 (1)	286 (3)	796 (2)	538 (1)	—	424
1945...	—	—	960 (2)	892 (3)	712 (1)	881

The figures in parenthesis are the numbers of fields, planted on different days of the month, contributing to the average. It will be seen that the yields from the June and July sowings are the highest on record. The August sown field was stony and badly eroded so that its yield can be put at rather more than its face value. A small variety trial planted on the experiment farm early in September, yielded nearly 800 lb. per acre. It remains to be seen whether the same general story will be repeated in other years.

Genetics and Breeding.

Owing to the heavy stainer attack in the previous season all work was very much hampered by bad germination.

Blackarm Resistance.—The transference of blackarm resistance to BP.52 continued, but it is emphasised that it is proceeding empirically without reference to the gene or genes involved. Dr. Knight has been asked to visit Uganda to investigate this point.

Wilt Resistance.—A small trial with 18 replications (on the same lines as the one last year) was planted to test KP.28, KP.40, their F_1 and F_2 hybrids and both back-crosses. The percentages of plants which developed symptoms of wilt (after using a square root transformation) were as follows :—

	External Symptoms during Growth.	Internal Symptoms when Uprooted.
KP.28	1·0%	15·2%
KP.40	44·7%	64·1%
F_1 hybrid	11·8%	31·9%
F_2 hybrid	13·9%	42·8%
Back-cross to KP.28	6·7%	30·9%
Back-cross to KP.40	22·3%	47·5%

It is plain that resistance to wilt is being inherited in a rational manner, but it is still not possible to say whether a simple or complex genetic system is at work. It remains to be seen whether the full resistance of the donor parent can be recovered by selecting segregates from a selfed backcross population. Meanwhile the routine transference suggested by Mr. Hutchinson is continuing.

Seed Type.—The transferences described in last year's report are continuing. This subject is referred to again under the heading of maintenance.

Red Plant Body.—The transference of the gene R_1 to strains with different types of plant habit is now being started systematically. The plan is to elucidate the linkages which operate and then use them to measure the adaptive advantages of different plant habits under conditions of *Lygus* and blackarm attack. Three features of plant habit are to be considered, singly and in combination :—

(*a*) semi-cluster habit as described in America,

(*b*) strong development of basal monopodia,

(*c*) development of subsidiary monopodia from buds which remain dormant in the normal plant.

Tomentum.—The transference was begun of tomentose hairiness from existing hybrid material (*G. tomentosum* × *G. hirsutum*) to the varieties MU.8A and BP.50, which have good normal hairiness. This is being done as a possible means of gaining resistance to *Lygus*, but no effect can be observed yet because tomentose hairiness is only fully expressed in the homozygous condition.

Okra Leaf.—This character is being transferred to the variety BP.52 to observe the effect of a more open ecoclimate on insect behaviour. Again no observations can be made until the character is recovered in the homozygous condition.

Maintenance.—This season there was a marked increase in the proportion of black seeds throughout the commercial areas of BP.52 in Buganda. It is clear that there is a considerable selection pressure in favour of this character (which derives from the old Buganda Local seed) and it is likely that it operates by differential germination. This would account for the fact that the effect is more marked in certain years. All Bulemezi received new seed in 1945 and in contrast to the experience of the previous season the access of black seeds in the new seed completely nullified the work and expense of replacement (that is, the proportion of black seeds remained the same in Bulemezi when it should have improved). Clearly if our present seed replacement scheme cannot overtake this selection pressure then it will not achieve the distribution of pure BP.52 throughout Buganda. The obvious botanical solution to this particular problem is to transfer the tufted (" black ") seed type to BP.52, if this can be done without detriment to other characters. But that does not absolve our seed distribution scheme from criticism.

The special bulk of BP.52 seed made up from 150 re-examined progenies gave an excellent yield at Kawanda and realised over 900 lb. of first-quality seed. The whole of Bukalasa farm is to be planted with it this year. In this bulk semi-cluster habit and the development of basal and subsidiary monopodia were noticeably more prominent than in commercial stocks. During a visit to Ukiriguru Mr. Pearson found that this was also true of each of the 150 progenies planted there individually, under conditions quite different from those in Uganda and free of *Lygus* attack. This is interesting because it shows that the author has further emphasised these characters when re-selecting.

This happened in spite of the fact that the single plant selections were made in a field badly damaged by *Lygus*, so that plant habit was hardly recognisable. These facts seem to clinch the contention that these characters have been brought out by empirical selection.

Variety Trials.—A 5 × 5 lattice square was planted at Kawanda on 17th July. The germination of several varieties was irregular and comprehensive comparisons had to be limited to characters with small environmental variation, such as ginning percentage and lint length. Restricted comparisons of other characters were possible between the few varieties which germinated normally. BP.52 as control yielded rather more than last year at 260 lb. of clean lint per acre. The early-maturing variety KP.40 ex BP.50 gave 308 lb. per acre. Somewhat surprisingly, B.181 gave 406 lb. per acre, the highest yield of all. Examination of past records shows that B.181 is more variable in relation to season and locality than in relation to sowing date. MU.8A and some other introduced varieties succumbed to wilt and yielded very poorly.

The district variety trials were devoted to the same varieties as in the previous season, but no sowing was permitted until July or later. KP.28 and BC.6/14 germinated badly, so yield comparisons were limited to BP.52, B.181 and X.3. The Bulindi trial was planted on 3rd August and yielded 402 lb. of clean lint per acre. The Kawanda trial, planted on 4th September, yielded 256 lb. per acre. The three centres in Bulemezi and Singo (Kalagala, Bukalasa and Bukomero), planted in July, all yielded well over a bale an acre. Variety comparisons were of minor interest, but it is again clear that our previous conclusions about the value of early sowing are due for careful revision.

Spinning Tests.—The Shirley Institute kindly undertook spinning tests on a large number of samples from the 1944–45 season. Small-scale tests on samples from the variety trial at Kawanda showed that the spinning quality of BP.52 (count-strength product of about 2,500) has been fully recovered in the third and fourth backcrosses for blackarm resistance. This is a most gratifying result. B.181 and its derivatives were a good deal weaker at 2200–2300, but derivatives of BP.50 scored about 2400. Full-scale tests on samples from the district variety trials favoured BP.52 and BC.6/14, but the latter variety is not resistant to blackarm and has now probably lost any interest that it might have had. Some interesting locality differences came to light and a sample of BP.52 grown in Toro (from ordinary bulk seed) gave a highest standard count of 94, the highest ever recorded in Uganda.

Seed Distribution.—All seed in Bulemezi and near its borders (the heart of cotton growing in Uganda) was replaced in 1945. Fresh relatively pure seed was brought in mainly from North Kyagwe, but also from Buruli and Singo. The results have already been described. No seed replacement has been planned in 1946 outside the legally segregated areas; the abrupt increase in the proportion of the old type has left us bereft of big stocks sufficiently pure to be worth while

moving further. This paralysed condition is serious and presents a very difficult problem.

The mixture X.3/38 in South Masaka suffered another bad season which undeservedly diminished its reputation. This was due to drought on an unfavourable soil type, which brought on a widespread *Alternaria* attack. It has been decided not to proceed further with the distribution of X.3/38 this year for two reasons. The transference of blackarm resistance to BP.52 by genetic means has rendered this mixture out of date. Furthermore it is felt that the time has not yet arrived to abandon Buganda Local as a fair-sized commercial bulk from which further new material can be selected.

Plot Technique.

One field of cotton and one of sweet-potatoes were harvested as uniformity trials, but it will take some time yet to complete the reduction of the results. In the meantime gully-filling, levelling, cultivation and continued care generally are bringing about an obvious improvement in the uniformity of the experimental land. So the detailed treatment of uniformity data might well be postponed until this process is still further advanced. Ploughing equipment is still a limitation, but it is hoped that it will be possible to find a one-way plough suited to Kawanda conditions.

Entomology.

It has been stated in an earlier section that *Lygus* damage was light and other pests negligible.

Mycology.

Blackarm and wilt have been dealt with in earlier sections. *Alternaria* and associated fungi caused quite considerable damage to cotton along the shore of Lake Victoria between Entebbe and the Tanganyika border. This condition seems to be associated with the occurrence of drought on the very acid soil (a quaternary deposit) which is found near the lake shore. The increase of X.3 seed in south Masaka was affected and also Nkozi and Kyanamukaka variety trials. Nkozi trial suffers chronically from *Alternaria*. There are indications that resting this soil under elephant grass greatly alleviates the trouble.

PROGRAMME FOR 1946-47.

Agriculture.

Sowing Date.—This problem will be studied in all possible ways. A series of trials will be started along the lines adopted by Messrs. Pearson and Mitchell in Nyasaland. At Kawanda there will be a series of eight trials, each comprising three sowing date treatments spaced at intervals of a fortnight. The trials will be separated in space and have a two-thirds overlap in time. Thus there will be in all, ten fortnightly sowing dates ranging from 1st May to 4th September.

SERERE AREA.

PROGRESS REPORT.

BY

P. E. WEATHERLEY.

Introduction.

During the 1945–46 season breeding work was largely restricted to increasing and testing the blackarm-resistant strains already isolated. Unfortunately it was not possible to carry this work as far as was hoped, owing to poor yields from the increase rows of the previous season. This prevented the inclusion of blackarm-resistant strains in the district variety trials, so that no information could be gathered about the performance of these strains in various parts of the country.

All cotton suffered from the usual severe shedding of squares and bolls generally attributed to *Lygus*, whilst blackarm attack was, on the whole, more severe than usual.

Exploratory work on cotton physiology continued.

Meteorology.

1945 was a year of exceptional rainfall distribution. It will be seen from the table that the early rains failed in April and broke heavily a month late. Following these heavy rains the "short dry season" in June, was drier than usual. The second rains were very heavy, but the figures give a wrong impression of their duration, for November was a dry month, two-thirds of its six and a half inches falling on two days towards the end of the month.

	Serere Rainfall (inches).		*Sowing.*	*Harvesting.*
	1945.	*Mean 1921–45.*		
January	0·85	0·83	—	Food and Cotton
February	2·23	2·45	Food	Cotton
March	1·19	3·53	Food	—
April	1·43	7·83	Food	—
May	12·98	7·31	Food and Cotton	—
June	1·90	4·30	Cotton	Food
July	5·17	4·57	Cotton	Food
August	10·19	6·47	Food and Cotton	Food
September	9·94	6·03	Food	—
October	4·05	4·34	—	Cotton
November	6·51	4·00	—	Food and Cotton
December	0·35	2·03	—	Food and Cotton
TOTAL	56·79	53·69	—	—

The lateness of the main rains upset the normal agricultural sequence of the country. Early grain crops were about two months later than usual; this not only delayed the sowing of cotton following

Eleusine millet in the rotation, but also the sowing of cotton on new land, the result being that the sowing of cotton throughout the district was markedly later than usual. This, together with the fact that the second rains were not unusually prolonged, meant that the " growing season"' was about two months shorter than can be expected normally.

Conclusions from Work Done in 1945–46.

Agriculture.

Manurial Trial.—This trial was under cotton in the first year of its fifth cropping cycle, farmyard manure being applied before the cotton was sown. There was a strong linear response in yield of cotton to dressings of manure, the heaviest dressing (30 tons per acre) giving yields three times as great as the unmanured plots. This was in contrast to previous years in which the heavier dressings tended to depress yields of cotton.

Cotton Seed and Meal Manurial Trial.—After three years resting this trial was sown with groundnuts followed by sorghum to test the residual effects of manures last applied in 1939. None of the treatments had any significant effect on the yields of groundnuts, but the effect of manures on the yields of sorghum was significant. Cotton seed at the rate of 2 tons to the acre, and cotton seed meal at the rate of 1 ton to the acre, increased yields by approximately forty per cent., whilst the heavier dressings of 4 tons of seed and 2 tons of meal caused no further increase in the case of meal, and depressed yields to the level of the control plots in the case of cotton seed.

The response to cotton seed meal was greater than that to the raw seed, but in both cases the response was remarkable considering the lightness of the dressings, and the length of time since their application.

Fertility Experiment.—The results followed those of previous years, cotton in the first year of the rotation, i.e., on newly opened up land, gave no response to farmyard manure. Cotton in the second year of the rotation, following *Eleusine* millet, gave a marked linear increase in yield in response to increased dressings of manure. Yields here were very low probably owing to excessively late sowing following the harvesting of millet. (See section on Meteorology). *Eleusine* millet once again gave increasing yields with increasing resting period and decreasing cropping period, but the cotton following the *Eleusine* showed no such response.

Interplanting Experiment with Cassava.—This was a repetition of the previous year's trial except that cassava only was used for interplanting. Cotton was spaced at the usual 3 ft. by 1 ft. and the cassava spaced at 6 ft. by 6 ft. and between the rows of cotton. Cotton was sown at the end of June and cassava planted in the middle of August and October.

Interplanting made no detectable difference to the yield of cotton even with the earlier interplanting, which did depress yields in the previous season's trial. Although cassava yields were not measured, the " take " was quite good and would have assured a supply of food in the middle of 1946 or later.

Interplanting Experiment with Beans.—In this experiment cotton was interplanted with beans and the yields of both cotton and beans compared with the corresponding yields from the crops growing by themselves. Two kinds of beans were used, Canadian Wonder and Tepary, which were sown ten days after the cotton. There were two replications one sown in June and the other in July.

At neither of the sowing dates were any differences found between the yields of cotton when grown by itself and when interplanted. Similarly interplanting had no detectable effect on the yield of either Canadian Wonder or Tepary beans, but yields of beans were rather irregular and only fairly large differences were detectable.

N.P.K. Experiment.—Final crops of *Eleusine* millet followed by cowpeas were grown to test the residual effects of manures applied to the cotton grown in 1944. The yields of *Eleusine* showed responses to dressings of ammonium sulphate and calcium phosphate, but cowpeas showed no such response.

Cotton Breeding.

Blackarm-resistance.—The selection of resistant genotypes being completed there remained only to test the resistant varieties in trials and to increase the more promising. As indicated in the introductory paragraph, there was a severe shortage of seed of most varieties, so that adequate testing as well as increase was not possible. Some varieties had to be increased once again in rows with flower tying to ensure selfed seed.

As a result of the Blackarm Project, we now have six resistant selections from N.17, six resistant selections from B.181, and a bulk mixture of resistant selections from BP.50R. These selections were compared with their parental types and other commercial varieties such as BP.52 and SP.84 in a variety trial of lattice square design. Unfortunately this trial suffered from poor germination so that yields had to be corrected for stand. The routine blackarm lesion counts did not clearly demonstrate the resistance of the blackarm-resistant strains compared with their parental types, although the marked resistance of B.181 and its derivative was clearly shown. The best resistant N.17 derivative gave a yield of 202 lb. of lint to the acre as against 123 lb. to the acre, the average for the commercial N.17 bulks. As in the previous year the highest yields came from B.181 and its derivatives, the best of which yielded 237 lb. of lint to the acre and had a lint length greater than any of the N.17 selections as well as SP.84. The blackarm-resistant bulk of BP.50R selections yielded 197 lb. of lint to the acre.

District Variety Trials.—Trials were conducted at nineteen centres throughout the district. The major varieties N.17, BP.52, BP.50 and B.181 were grown at most centres together with KP.28 (related to B.181), S.4105 (ex N.17. M2) and SP.84 (ex U.4/4/2) according to locality. The results of the blackarm lesion counts were broadly similar to last year ; B.181 and KP.28 showed strong resistance everywhere, whilst BP.50R was better than the rest, and N.17 and its derivatives were distinctly more susceptible. As regards yield B.181 was highest everywhere, although SP.84 approached it at Katakwi more nearly than in recent years. BP.50R and BP.52 gave rather similar yields, somewhat lower than B.181. The salient feature though, was that N.17 was outyielded practically everywhere by the Buganda varieties BP.50R and B.181 (and KP.28), and by the Nyasaland Upland BP.52. There was thus a rough correspondence between yield and blackarm-resistance, but it cannot be said whether this disease is the yield controlling factor until blackarm-resistant selections of N.17 are included in the district variety trials. This will be possible in the 1946–47 season.

Plant Selection.—Single plants were selected on vegetative characters, mainly branching habit, in fields of KP.28 (a B.181 selection made at Kawanda) and blackarm-resistant BP.50R, with a view to examining the progenies in the 1946–47 season.

Type Collection.—This was discontinued apart from the maintenance of a few varieties of local interest.

Spinning Tests.—Samples from the 1944–45 district variety trials were bulked by localities in the usual way, four varieties being compared in N.W. Uganda, Teso and Lango, and Bukedi. In the first two of these localities BP.52 gave the strongest yarns, with little difference between N.17, BP.50R and B.181 which were weaker. In Bukedi, on the other hand, BP.52 was surpassed by B.181 in strength, the remaining two varieties giving yarns considerably weaker. On the whole B.181 was best in appearance in each locality and BP.52 poorest. Small-scale spinning tests emphasised the good appearance of B.181 and N.17, but differences in strength were small.

Seed Distribution.—The increase of B.181 in N. Teso continued for the third year. The Lalle segregated area was supplied from Serere, and the total area under B.181 amounted to 16,000 acres. Since Serere supplied Lalle with B.181 it could not also supply improved N.17 destined for S. Teso, thus the Mulondo segregated area supplied its own seed as well as Labori-Kadunguru. In N. Mbale SG.29 was finally replaced by BP.52. The supply of S.4105 (ex N.17.M2) to Busoga through the seed farm at Nakabango broke down owing to contamination with seed from outside sources at the hundred-acre stage.

Physiology and Entomology (1).

Lygus attack.—The late ripening and harvesting of the grain crops, and perhaps also the correspondingly late maturation of wild

(1) The assistance of Mr. H. S. Darling, entomologist, is gratefully acknowledged.

host plants, delayed the migration of *Lygus* on to cotton, so that the onset of the *Lygus* attack was delayed by as much as two months (see paragraph on Meteorology). May-sown cotton, therefore, escaped attack during the first three months of its life, and this may have accounted for the fact that some May-sown plots on the Experiment Farm yielded at the rate of over 1,000 lb. of seed cotton to the acre.

Lygus leaf damage developed at the end of August and during September. As far as could be judged the attack was rather less severe than usual, and in support of this there was definite evidence that the *Lygus* population was below normal. A grand total of 9,000 net sweeps made in ripening *Eleusine* millet at Serere during July and August, took an average of four adult *L. simonyi* per hundred sweeps, with a maximum of eight per hundred sweeps in early August. A similar survey made by A. M. Gwynn (2) in June of 1937, considered a normal year, gave an average of twelve adults per hundred sweeps. It is conceivable that this low population was the result of the abnormally long drought, extending through the first four months of the year, which might have reduced the number of *Lygus* adults surviving from the previous rains.

Sowing Date Trial.—This was of the routine form based on contiguous plots sown at different times. The plots were sown in May, June and July. The effect of sowing date was very marked, the May sowing yielding more than four times as much clean lint as the July sowing. This may have been partly due to the fact that the early-sown cotton escaped attack by *Lygus* during its early stages, as indicated above. On the other hand it is not known whether it subsequently underwent an attack equally as severe as the second or third sowings, for no adequate method has been developed for assessing *Lygus* damage on cotton plants. The leaf damage counts which are done as routine at this station, are useful for comparing the extent of leaf damage on fairly similar varieties at a given age. On the other hand they are of much less use in following the attack on a group of plants from time to time, or comparing the attack on plants of different ages at the same time.

The May-sown cotton set a number of bolls on the lower sympodia, but few of these reached maturity, although the reason for this was not clear. It would seem that this loss could not have been due to *Lygus* since many of these lower bolls had grown beyond the stage at which they are considered to be susceptible to *Lygus* attack.

Cotton Leaf Physiology.—This work followed up the attempt made in the previous season to investigate the changes occurring in cotton leaf tissue during the development and ageing of the plant. Once again it was largely a study of methods.

In the 1944–45 season the leaf punch method of sampling was used, and it was found that if constituents such as dry matter or water were expressed on a sample basis (i.e., an area basis), the trends in

(2) Unpublished manuscript.

dry weight and water content were quite different. The dry matter increased as the plants developed, whereas the water content remained relatively constant. This result was difficult to interpret since variations in leaf thickness were not taken into account. During this season an attempt to overcome this difficulty has been made by not only measuring the thickness of the discs, but also the actual volume of cells in each sample, after the discs had attained full turgor by floating on water. It was found that considerable fluctuations occurred in cell volume of the samples from time to time through the season. This at once eliminated the usefulness of following trends in leaf constituents on an area basis. Even so the main results of the previous season were confirmed; when expressed on a cell volume basis it was found that the dry weight increased considerably as the plants developed, whilst the water content showed relatively small changes. In addition the protein nitrogen content of the samples was estimated since it was thought that this might be a logical basis on which to express leaf hydration. The weight of protein nitrogen increased with the age of the plant in a similar way to dry weight, and seemed to have no advantage over the latter in expressing changes in leaf hydration.

As might be expected there was a close correlation between the cell volumes of samples and their water contents when fully turgid. This leads to the tentative suggestion that the water content of the fully turgid sample is a useful basis on which to express its water content as found on the plant in the field.

It was confirmed that the proportion of water to dry weight was similar for different aged leaves and even buds, found on a plant at a given time, and that this proportion fell in all the age categories investigated, as the plants developed. In other words it seems justifiable to conclude that the dry weight per unit cell volume increased in leaf tissue, including buds, as the plants developed. The inclusion of buds is important from the viewpoint of *Lygus* attack, since this insect only attacks very young developing tissues. It is possible that herein lies a clue to the greater resistance to attack, of older, as compared with younger plants.

PROGRAMME FOR 1946-47.

Agriculture.

Manurial Trials.—Sorghum followed by cotton.

Cotton Seed and Meal Manurial Trial.—Completed.

Cotton Seed and Ash Manurial Trial.—Resting.

Fertility Experiment.—Continues.

Interplanting Experiments.—To be discontinued for the present.

N.P.K. Experiment.—To be discontinued in view of further trials to be started at Serere by the Senior Chemist.

Genetics and Breeding.

Blackarm-Resistance.—Resistant material to be increased and tested in trials.

District Variety Trials.—Promising blackarm-resistant selections from the main families to be tested in various localities.

Plant Selection.—Single plant progenies from blackarm-resistant BP.50 and KP.28 to be examined.

Physiology.

General study of cotton leaf hydration and water relations to be continued.

TANGANYIKA TERRITORY.

LAKE PROVINCE.

UKIRIGURU AND LUBAGA EXPERIMENT STATIONS.

PROGRESS REPORT FOR THE SEASON 1945-46.

BY

J. E. PEAT.

COTTON.

Station.	*Planting period.*	*Picking period.*	*Legal Uprooting Date.*	*Seasonal Rainfall 1st Oct. –30th June.*	*Distribution.*	*Notes.*
Ukiriguru : 1945–46 ...	Late Nov., Dec., Jan.	May–Aug. (nearly 4 months)	7th September	27·02 inches	Difficult	Heavy rains in November : in December and January only showers : very dry February to mid-April : rains from then until mid-May good.
Generally	Late Nov., –December	May–August	7–15th September	—	—	
Lubaga : 1945–46	December–January	June–early September	7th September	21·87 inches	Very difficult	The lowest rainfall recorded and very bad distribution. January, February, March very poor. April good.
Generally	December–January	June–early September	7th September	—	—	

INTRODUCTION.

In August, Ukiriguru was visited by Mr. Creech Jones, now Secretary of State for the Colonies. These stations have also been visited during the season by a large number of people concerned in the improvement of the agriculture of the Province—administrative officers, technical officers, chiefs and headmen.

Mr. A. N. Prentice started the season's work at Ukiriguru. The writer returned from leave on the 1st January, 1946. Mr. Prentice was then stationed at Lubaga until he went on leave at the end of July. Mr. A. M. Pienaar continued as Agricultural Assistant at Ukiriguru during the season.

Mr. J. B. Hutchinson toured in the Lake Province in June. This visit, and the opportunities for discussion which it afforded, were much appreciated.

An arrangement for co-operation in the investigational work required in the cotton areas has been agreed to by the Tanganyika Government and the Corporation. In the Lake Province the work is to be centred on Ukiriguru with substation work at Lubaga, the whole supported by a series of district plots. The staff will be centred on Ukiriguru as soon as the necessary housing and other buildings are ready.

Present working arrangements are crude, and a considerable amount of time is taken up with development. Until working facilities can be improved and staff provided, much of the work is approached more superficially than is desirable. Much of the important following up work is hardly possible.

For the present the work attempted covers the various aspects of cotton growing in the Lake Province, with as much work as is at present possible on the all-important fertility problems of the area. Some of the benefits to be derived from food crop work have been outlined ; but though this is very important, only a little can be done until further facilities are available.

The Ukiriguru and Lubaga results show how a considerable increase in cotton production could be possible—always assuming that no new unforeseen factors arise to upset estimates—certainly with no general increase in the acreage planted, but even with an acreage reduction in the exhausted areas. The improvements visualised are simple improvements in seed and in husbandry. Essentially they are the growing of improved strains—vigorous, better yielding, and with jassid resistance : the planting of cotton only on reasonable land not completely worn out : better ridging and tieing in the areas where ridging is practised, and tie-ridging where at present flat cultivation is more general : and anything that can be done to raise even a little the level of fertility.

The 1946 Cotton Production.

The Lake Province lint production for 1946 is estimated to be nearly 34,000 bales, about average for the Province. The crop for the South of the Province, owing to the very difficult rains, is very low —about 2,000 bales from the Maswa District and 1,000 bales from Shinyanga District—but production near the Lake shore is good, not far short of the best year to date, 1941. Mwanza District produced nearly 21,000 bales, and Kwimba District around 7,000 bales. The season was not a good one, but the cropping period was long, and pests were not serious.

Weather.

As outlined in the introductory table, it was a droughty year. Planting conditions were fair near the Lake shore, not so good inland. The droughty period from the end of January until mid-April was difficult, then for about a month rains were good. Nearer the Lake shore these rains helped the cotton top crop considerably.

General Account of the Work of the Season 1945–46.

Husbandry.

Soils.—The cotton yields at Ukiriguru were good—very good indeed on the " mbuga," the heavy black valley-bottom soil. There the best strains in the variety trial, unmanured, reached up to around

2,000 lb. seed cotton per acre : strain yields were between this and 1,500 lb. per acre. Considering the season, yields were surprisingly good on the hill lands, manured at 5 tons per acre—up to over 1,300 lb. seed cotton per acre.

At Ukiriguru in the past few dry seasons the value of the rich " mbuga " soil for growing excellent crops of cotton has been demonstrated. In wet years these soils become waterlogged, and the cotton suffers from Capsid (*Lygus*) damage. On this heavy land the grains suffer more than cotton in droughty periods ; and sorghum suffers seriously from *Striga helmonthica*. The Ukiriguru " mbuga " is ploughed after harvest, and can quickly be prepared for planting at the first rains. Such timely ploughing, as distinct from purely hand-hoe cultivation after the rains break, would probably be a pre-requisite to a more general use of these rich soils. Much more general use of ploughing could be made on the undulating, moderately heavy, soil areas in Central and South Sukumaland. In these areas cropping in strips roughly on the contour, using grass leys on the Teso, Uganda, pattern, would seem to be the approach.

At Lubaga the patchy early rains meant that the young cotton suffered badly in the January-March drought. Moderate cotton yields were obtained in some plots. Grain crops were a failure. The April rains were too late to be worth while. On similar " ibushi " soil, in a district plot on the Shinyanga-Maswa border, early planted cotton trial yields were up to around 1,000 lb. seed cotton per acre.

**Tie-ridging*.—[Ridges, approximately on the contour, tied every five feet or so with cross ridge ties.]

Taking the Province as a whole, in these droughty years possibly one of the most important lessons that is being learned from these stations is the great value of good tie-ridging in bettering yields. In the North of the Province broad-based ridging is the custom. The need here is for a better standard of ridging and cross-tieing. Towards the South of the Province a considerable improvement would be effected if tie-ridging could be extended, instead of the present more general cultivation on the flat. The valley-bottom soils, and land which becomes waterlogged, would be excluded.

Tie-ridging was originally practised on the stations primarily to prevent soil loss, but the increased yields due to the holding up of rain are in themselves highly important. At Lubaga in recent years increased yields of cotton and grain amounting to approximately 100% have been obtained in trials comparing tie-ridging with flat cultivation. In some circumstances more than double this increase has been obtained, in other circumstances less. Even this past year, though tie-ridging could not save the grain crops, the cotton yield differences were striking.

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* A. N. Prentice. Tie-Ridging (with special reference to Semi-arid areas). The East African Agricultural Journal Vol. XII., No. 2, October, 1946.

At Ukiriguru the original main intention of tie-ridging was to prevent loss of the finer soil fraction where ridging could not be truly on the contour. The good crops resulting, compared with the crops on poor native ridging untied, on land adjoining Ukiriguru, have been recorded each year. Controls in trials on the hill sands, and exhaustion plots not receiving other special treatment, have yielded over the last few years from 500 lb.–800 lb. seed cotton per acre, and from nearly 500 lb. upwards of millet per acre. These are very reasonable returns for the poorish soil and the droughty seasons, with no manuring or other fertility improvement. On the whole, cotton yields have been better than millet yields. Therefore taking the long term view, with the market price of bulrush millet 5 cents per lb., and Grade A seed cotton, 15 cents per lb., the cultivator is considerably better off with cotton, rather than with surplus millet for sale—once his own food requirements are satisfied and he has secured an adequate food reserve as an insurance for bad years. The return for much of the cotton grown at Ukiriguru this past season exceeded £8 per acre ; for some of it the return was appreciably greater.

A trial is now being started to measure, over a period of years, the improvement in yield on these hill soils directly due to good tie-ridging as compared with ordinary rather mediocre native ridging, untied. These comparisons are being extended to district plots.

Manuring.—At Lubaga no further manurial results were available. Manurial responses there on the heavier soils are low. At Ukiriguru, the better trials, from which results are now available, show that the residual responses from manuring are greater than was at one time thought.

In the 1945–46 first year response manurial and resting crop trial, the increased yield of grain from the application of manure was heavier than usual—around a 50% increase of bulrush millet from a 3 tons per acre dressing of compost. The mean control yield was 560 lb. per acre. A 400 lb. per acre dressing of Uganda raw rock-phosphate gave up to a 30% increase. [The question of phosphate availability has to be considered. East African silico-phosphate is being used for the new 1946–47 experiments.]

From the manurial experiment laid down in 1944–45, a second year residual benefit of over 45% increase was obtained with bulrush millet following the 7 tons per acre farm yard manure and compost dressings. A 30% residual benefit followed the 1½ tons per acre cotton seed ash dressing, and over 10% followed the 3 tons per acre farm yard manure and compost dressings. The control yield of bulrush millet averaged nearly 500 lb. per acre.

From the manurial experiment laid down in 1943–44, a third year residual benefit of 50%–60% increase of seed cotton was obtained following the 1943–44 application of 3 tons per acre cotton seed ash. (Dr. W. S. Martin estimates this cotton seed ash to contain around

15%–20% P_2O_5.) From the two treatments, 7 tons per acre farm yard manure and 7 tons per acre compost, the residual increase was in each case about 40%, with smaller residual increases following the 3 tons per acre dressings. The control plots yielded around 700 lb. per acre seed cotton.

This year, contrary to the results reported for last, no rotational increase was obtained with bulrush millet following cotton, compared with bulrush millet following bulrush millet.

Land Resting.—The Lubaga resting crop experiments, opened up for the cropping cycle this season, unfortunately could give little worthwhile information. Grain crops were a failure, and the cotton was patchy. But sorghum, following a three years' growth of the grass *Kavirondo sorghum*, seemed to be noticeably depressed.

Last year the Ukiriguru resting crop trials, opened after three years under resting crops and planted to a millet-sorghum mixture, showed up to a 30–40% increase after three years of elephant grass grazed down only prior to the digging in, and a 45% increase after three years' pigeon pea. But manuring at the rate of 5 tons per acre, both after continuous grain crops and after three years of elephant grass, gave a 60% increase. This year, the second year of the cropping cycle, the only increases of seed cotton are the second year residual benefits from the manurial applications. Apparently no benefits, after the first year, have remained from the resting crop treatments. Dr. W. S. Martin, to whom we are greatly indebted for structure and other tests on samples of Ukiriguru and Lubaga soils, has shown that under none of the treatments was there any improvement in soil structure. Stands were only fair and these results will be followed up, but it would look as though on the Ukiriguru hill sands, the benefits from the incorporation of the resting crops had been dissipated in one cropping year. Where the whole elephant grass crop dug in had also a 5 tons per acre manurial application, no second year benefit seems to have been derived from the digging in of the considerable crop of elephant grass, as compared with control millet similarly manured. Earlier observations gave indications of this rapid dissipation of incorporated green material. In the new experiments, the leys will be grazed at intervals, adding manure that way. This is of course impossible in tsetse country. These preliminary results are highly important in their influence on the approach to land resting and ley farming under these light soil, tropical conditions.

Two resting crop trials, grazed at intervals during the past two years, are being opened for this coming season.

The new ley trials, testing leys of indigenous grasses, and with legumes undersown, are, apart from control variants, being grazed at intervals during their cycle.

A full N.P.K. trial will be started as soon as land and facilities permit.

Indigenous Grasses and Legumes.—At Lubaga and Ukiriguru the collections of indigenous grasses and legumes have been increased. At Lubaga the selection work in *Cenchrus ciliaris* has produced some very useful spreading types. These are also doing well at Ukiriguru. *Cenchrus ciliaris* tends to rather heath-like growth when established, leaving bare ground between the tufts.

The best grass types, in mixtures, are being planted in the trial leys: *Cenchrus ciliaris, Panicum maximum, Brachiaria brizantha, Botryochloa insculpta, Chloris gayana.* Some of the indigenous bottom legumes look promising, and are being sown in some of the trial ley variants.

Food Crops.

Millet and sorghum are the main grain food crops in the area the stations serve. Millet in most years is fairly safe apart from bird loss. Sorghum suffers badly from stalk-borer in some years. Maize is a doubtful crop in dry years. The sorghum varieties in general cultivation by the people are medium to rather long-term varieties. In reasonably good years and under good conditions they yield well and store well, but in seasons of patchy rains the planting of some early-maturing types would seem to have real value as an insurance. Unfortunately the early types are poor storers. A range of early-maturing sorghums from Wad Medani, kindly supplied by Mr. Evelyn, are to be tested.

This past season in a trial in the "mbuga" at Ukiriguru, the Swaziland sorghum P.41, an early-maturing variety, yielded at the rate of 2,000 lb. per acre. Feterita selections yielded around the 1,500 lb. per acre mark. Contrasted with these, Dobbs, a good medium-early variety, yielded only 300 lb. per acre. Bulk Dobbs planted slightly later yielded less. The plants headed, but, being caught by the drought, the grain did not fill. *Bukura mahemba*—a medium-late variety grown in the same area was attacked by stalk-borer, and also yielded only about 300 lb. per acre. Long-maturing Wiru varieties benefiting by the April rain yielded appreciably better. The testing and supply of seed of the best early-maturing sorghum varieties is important.

Loss from *Striga helmonthica* is a very serious handicap to the use of the "mbuga" soils for sorghum growing. In an experiment on the "mbuga" at Ukiriguru all the plots were weeded once: *Striga helmonthica* was allowed to develop in the controls: the other plots were kept clean weeded. *Bukura mahemba* was the sorghum variety used: it suffered severely from stalk-borer damage. The mean yields were 313 lb. per acre clean weeded, to 23 lb. per acre control: but the differences are better shown as 4,397 lb. stalks and heads clean weeded; 652 lb. per acre control.

Cotton Breeding.

Cotton yields were good : very much better than was at one time thought probable. Each year it is increasingly apparent that with a long cropping season, even under difficult conditions, reasonable to good crops are obtained. With a four months' picking period on only moderate soil, and in spite of a difficult year, given good tie-ridging and no markedly serious pest loss, the yields that can be obtained from quite ordinary looking cotton are surprisingly good. In contrast, very much of the native cotton—and the food crops—are distressingly poor.

The first cotton seed issue since 1939 has been made, for multiplication on about 100 acres in Uzinza. This 1946 issue, the first of a series in view now that known strains of merit are becoming available, is a mixture comprised of seven strains from Ukiriguru and Lubaga of the general Mz. style of lint. They are UK.3/17, UK.3/33, UK.4/53, UK.4/86, L.2/14, L.2/62, L.3/1. The main ingredients are UK.3/33 and L.2/62. All the strains have distinctly better jassid resistance than Mz.561, which it is proposed to replace by this issue. This improvement in jassid resistance, which in some of the strains is distinctly good, is one of the main reasons for the issue. But each of the component strains has yielded well this year in the Ukiriguru hill and " mbuga " trials, and in the district plot trials ; and they have shown up well in the conditions of the year at Lubaga.

At Ukiriguru, in a long cropping season with to all intents and purposes no jassid damage, in the hill trial (a twelve replication, twenty-five strain, balanced incomplete randomised block trial) UK.3/17, giving 486 lb. lint (1,377 lb. seed cotton) per acre, outyielded Mz.561 in lint by 37%, and L.2/62 with 445 lb. lint (1,348 lb. seed cotton) per acre outyielded Mz.561 by 26%. In the " mbuga " trial, in the most uniform six replication unit, UK.4/53 outyielded Mz.561 by 28%, giving 680 lb. lint (2,100 lb. seed cotton) per acre : and UK.3/33 outyielded Mz.561 by 18%, giving 630 lb. lint (1,962 lb. seed cotton) per acre.

There were no yield differences between Mz.561, and " Local," which Mz.561 had replaced starting in the 1939–40 season.

From lint and ginning figures, and such spinning information as is as yet available, there should be a quality and ginning outturn at least as good as Mz.561, possibly somewhat better. Spinning details will be available from next season's trials, and commercial comment on the bulk multiplication.

It is proposed that this first issue should be followed by further issues of improved, more uniform, jassid-resistant, material of the same general style and qualities and later, if possible, by material having a measure of resistance to *B. malvacearum*.

A big range of very useful single plant selections will be grown in 1946–47.

Some of the Barberton U.4 × Cambodia, and U.4 × M.U.8, crosses, and similar U.4 × Cambodia crosses ex Gatooma are interesting cropping types. If a lint quality slightly lower than that of the Mz. strains were to be wanted, strains from these U.4 crosses would be available. They have good jassid resistance, and good ginning outturns. The best yielding type tested in trials, A.2120, is no better cropper, measured in lint yield per acre, than the best Mz. strains : and in spite of long and good looking lint, shows poorer spinning performance than was anticipated. In recent lots it has given the weakest lint of the samples submitted for spinning tests. At Ukiriguru, even on the rich " mbuga " soil, A.2195 and the parent M.U.8 were both too squat : they showed little yield improvement on Mz.561. A.2106, grown for the first time this season, looked well, and will be tested in the 1946–47 trials.

On a slightly higher plane than the Mz. material lots from B.P.52 —some possibly natural crosses—are yielding well, with at least reasonable jassid resistance. If a higher quality lint than that of the Mz. strains were to be wanted, strains supplying it might be found in this material. In the trials, the B.P.50 lots, though good looking, were amongst the lowest yielders.

The Barberton U.4 × Sea Island crosses again did not look settled at Ukiriguru. They lacked vigour; hairiness and the lint qualities were disappointing, and blackarm damage was especially bad. Again, for field qualities, A.3313/1 seemed the best. Special bulks and a few single plant selections were taken.

At Lubaga the 1946 analysis showed outcrossing of the order of 25%. Leaf laciniation was used as the indicator. In 1945 single laciniate-leaved plants were planted surrounded by normal plants : there was thus maximum opportunity for cross pollination.

Air Blast Saw Ginning.—In November, 1945, Tanganyika seed cotton (from the Eastern Province) was ginned at Messrs. Platt Bros., Oldham, on an 80-Saw Air Blast Gin, using various gin feeding speeds, for comparison with the same seed cotton roller ginned.

The lint was examined and spun at the Shirley Institute. Brokers judged the roller ginned samples to be better. But the Shirley Institute spinning tests placed the saw ginned samples better in yarn strength and yarn appearance than the roller ginned samples.

Cotton Pests and Diseases.

Jassid.—Jassid damage on the whole was light. Populations seemed to increase after the April rains, but were too late to cause damage. Fairly heavy jassid damage was reported from older played-out land in parts of Ukerewe Island : big crops were reaped there from the more fertile land. Jassid attack had little effect in the Ukiriguru cotton strain trials, where between each variant there was an interlarding of fairly jassid-susceptible " Local."

Leaf strips samples were taken through the life of the plants from A.2106, growing moderately on medium hill sand unmanured, and growing vigorously following heavy manuring. These were sent to Barberton for hair measurements and for comparison with similar samples taken there.

A range of B.P.52 selections were graded for jassid resistance for Mr. J. D. Jameson, Kawanda, in so far as was possible in a season of light jassid attack. One or two of the selections seemed to have fairly good hairs.

Stainer.—Taking the Province as a whole, stainer attack was comparatively light. At Lubaga it started later than usual, but eventually was moderately heavy. The idea of a large-scale stainer poisoning trial in the Shinyanga district had to be given up owing to the difficulties of the season. At Ukiriguru, where there is closer picking than is general, the percentages of Grade C cotton, not all of which is due to staining, were around 5% on the hill ; higher in the " mbuga." In the district plots, Grade C percentages were lower than usual, varying from 3–5% in plots near the Lake to around 20% in two Maswa district plots.

Other Pests.—At Ukiriguru, American bollworm started to cause damage at the beginning of February. Contrary to anticipations there was just the one brood. There was also some Spiny bollworm damage.

Aphis was quite bad in January. Capsid (*Lygus*) was unimportant at Ukiriguru. As always there was heavy to very heavy *Lygus* damage in parts of Uzinza, especially on land recently cleared. *Lygus* damage was also reported from parts of Ukerewe Island.

Red Bollworm (Diparopsis castanea).—In a safari in June to the Southern Province, Red bollworm was found in planted cotton as far North as the Lindi-Masasi road in the Lindi district. Wild cotton plants (*G. punctatum*) were infested, and two well-grown larvæ were found in fruits of *Gossypioides kirkii ;* for these hundreds of fruits were examined.

Bacterium malvacearum.—In the Ukiriguru area *B. malvacearum* was noticeably bad on stunted native cotton, growing on wornout soil. Young plants were killed off by blackarm thus reducing stand, and poorly-grown plants were distorted. These same serious manifestations of *B. malvacearum* was also observed in the U.4 × Sea Island hybrid material growing at Ukiriguru. [It is possible that the conditions of the past two seasons have favoured the manifestations of *B. malvacearum*. The early rains have been heavy, followed by droughty periods.]

On most of Ukiriguru, *B. malvacearum* was noticeable, but under the better growing conditions, and especially after the April rain, plants seemed to grow away from the attack. It is difficult to say what loss actually had been caused, as yields were good to very good. One strain, somewhat suspect because of *B. malvacearum* susceptibility, was amongst the top yielding strains in the trials : first in the " mbuga" trial, and fifth in the hill trial (25 strain trials). In Shinyanga there was *B. malvacearum* infection, but the attack faded as the season advanced.

It is certainly very desirable to have a measure of resistance in any strains issued. An attempt is to be made this next season to grade for resistance, spraying with *B. malvacearum* suspension, using Dr. R. L. Knight's technique. It is thought that at least B_2 might be present in the local material.

Summary of Main Results and Conclusions of the Year.

1. The value of tie-ridging was again apparent.
2. At Ukiriguru the responses, direct and residual, from manurial application are becoming known more exactly.
3. It would appear that at Ukiriguru, on sandy land, the benefits from three years under Elephant Grass had been dissipated in one year's cropping. There was no benefit to the soil structure.
4. Very good cotton yields were obtained from the Ukiriguru " mbuga."
5. The value to local agriculture of varieties of early-maturing sorghum has again been shown : they help to provide a grain insurance for droughty years.
6. The very serious loss caused by *Striga helmonthica* has again been shown.
7. A 1946 issue of cotton seed for multiplication has been made. It is a mixture of strains from Ukiriguru and Lubaga—the first fruits of the selecting and testing work of the past seven years. Good increases over Mz.561 were obtained from the component strains, in high yielding strain trials.
8. A big range of very useful single plant selections were made.

PROGRAMME OF WORK FOR SEASON 1946-47.

Fertility.—The residual responses to manurial dressings will be measured in experiments, four, three, and two years after the applications. Two resting crop trials will be broken up and be under their first crop, bulrush millet : and two resting crop trials will be in the third year of their cropping cycle. A new resting crop trial has been laid down, testing natural fallow leys, leys planted up with local

grasses, some interplanted with local legumes, and a manurial and a silico-phosphate application. There will be further trials testing the value of silico-phosphate on the main station and in district plots.

A trial is to be started to measure the yield benefits over a period of years, of good tie-ridging contrasted with mediocre native ridging, untied. This comparison will also be continued in district plots.

At Lubaga no new fertility experiments will be started, but those already in being will be continued.

Work on the collections of local grasses and legumes continues.

Food Crops.—There will be the usual grain trials with special attention to the early-maturing sorghums. The *Striga helmonthica* trial will be continued.

Cotton.—The cotton selection, testing work, and multiplication, continues ; this is a big portion of the work of the stations.

An attempt will be made to grade for *B. malvacearum* resistance.

EASTERN PROVINCE.

PROGRESS REPORT FOR 1945.

BY

A. G. BEBBINGTON.

Planting period	Mid-February to mid-April.
Picking	August to October.
Uprooting	31st October.

Introduction.

The report covers the work on the main site at Ilonga and on the district plots, six in number. All these were on the same sites as in 1944, with one exception. Owing to the fact that the local natives moved their gardens it was found necessary to abandon the plot at Kwa Dihombo and a new site was taken on Mission land with similar soils, six miles to the South, at Mvomero. The acreage planted at Ilonga remained the same as in the previous season.

Weather.

The so-called "short" rains broke early in November and continued without a break until somewhat droughty conditions prevailed during March. Very heavy rain fell in April which continued into May.

Agriculture.

As a result of the early and continuous rains, cultivation of native gardens was much hampered by heavy weed and grass growth. In spite of this there was a considerable increase in the acreage planted to cotton, and much of it was planted a good deal earlier than usual. In Kilosa district, in particular, very serious attacks of *Helopeltis* were experienced which in some cases completely destroyed the plants.

Very large populations of stainers appeared in practically all areas and the crop of the Province was the lowest for years. The excessive rainfall in April undoubtedly contributed to this by retarding growth. The effect of the heavy rainfall was well demonstrated by the fact that the usually dry and more unsuitable areas for cotton gave larger yields than normal. Pink bollworm also made its appearance very early in the season.

Planting at Ilonga and in the district plots was carried out during March. Conditions on Ilonga were difficult owing to the patchiness of the rainfall during the month and some of the cotton was very late planted.

Experimental Work.—Three spacing plant-density trials were laid down. Two of these gave negligible yields owing to insect pests, while the third at Ilonga indicated that, as previously, the safest spacing is 3 feet by 3 feet with two plants to the hill.

Cotton Breeding Work.

The testing of different varieties and strains, particularly with regard to their reaction to insect pest attack, was continued.

The variety trial of the previous season was planted again. The varieties used were the types forming the commercial crops of Buganda (B.P.52), the Lake Province of Tanganyika (Mz.561), Eastern Province Local, a Kingolwira selection (553) and M.U.8A, a strain of Malwa Upland. This last was again included to act as a standard on account of its high rate of flowering and early maturity which would appear to be necessary if improvement in the yields in the Eastern Province is to be made.

The variety trials were carried out on Ilonga and all district plots. The design was a randomised block with six replications as previously. The yields are given in the following tables ; they are not so strictly comparable as they were in 1944 as times of planting varied greatly, the trials at Morogoro and Mvomero being planted at the beginning of March while, the latest, that at Ilonga, was planted at the end of March.

Yields in lb. of Seed Cotton per acre.

Place.	*M.U.8A.*	*Local.*	*B.P.52.*	*K.553.*	*Mz.561.*
Ilonga	451	301	282	341	345
Mvomero	460	213	226	288	286
Mkundi	174	61	98	76	92
Morogoro	453	203	162	304	264
Mgera	No yields were obtained owing to complete destruction of the crops by insect pests.				
Kingolwira Village ...					
Kingolwira Farm	1,415	826	526	942	944

Yields in lb. of Lint per acre.

Place.	*M.U.8A.*	*Local.*	*B.P.52.*	*K.553.*	*Mz.561.*
Ilonga	157	92	102	106	114
Mvomero	159	65	82	89	94
Mkundi	60	18	35	23	30
Morogoro	157	62	58	94	97
Kingolwira Farm	491	252	191	292	313
Average as percentage of Local	209	100	96	123	133

According to soil conditions the plots may be classified as follows : (i) Alluvial soils.—Ilonga, Mvomero and Mkundi ; (ii) Intermediate.—Kingolwira Village, Mgera and Morogoro ; (iii) Dry.—Kingolwira Farm. All plots experienced very serious attacks from a mixture of insect pests and in particular from stainers. As a result yields were very variable and in two cases the crop was completely destroyed. Kingolwira Farm which is in an area normally classified as unsuitable gave extremely good yields, probably owing to the good rainfall and the absence of American bollworm and the fact that the trial was planted on some of the better soil on the farm in partly riverine alluvial conditions. In all trials, with the exception of Ilonga, M.U.8A was significantly better than Local, demonstrating again, the necessity for a more productive type.

The yield figures given in the tables are the totals of Grade I and Grade III which were picked. In view of the great difference in price

of the two grades it is interesting to see what the actual cash yield per acre was, in view of the very severe damage caused by stainer.

The figures given are those for Eastern Province Local in each case :—

TABLE OF CASH RETURNS PER ACRE. YIELDS GIVEN IN LBS. OF SEED COTTON PER ACRE.

Place.	*Total yield per acre.*	*% Grade III.*	*Cash return per acre in Shs.*
Ilonga	301	35%	32.32
Mvomero	213	78%	12.16
Mkundi	61	88%	2.99
Morogoro	203	80%	11.78
Kingolwira Farm	826	77%	50.88

Strain Trial.—A trial of 10 strains including five from Uganda was planted at Ilonga and in five of the district plots in randomised blocks with ten replications.

This showed three of the strains to be better in yield than Local although yields throughout were low on account of insect pests. These three strains, which are derivatives of Local, have been shown by spinning tests and a broker's report to be as good as or better than Local in quality. The Uganda strains, with the exception of B.P.52, were generally not different in yield from Local.

Single Plants.—A number of re-selections and new selections from Local made at Ilonga in 1944 were carried forward. Some of them showed considerable promise from the point of view of yielding capacity and lint quality and a number of special bulks have been made. Twelve small bulks of Sea Island × U.4 crosses were received from Barberton. These were on the whole rather disappointing as they were mostly late and did not open well. Forty selections of the earliest maturing types were taken from them.

Insect Pests.

Continuous records of the main pests were taken throughout the season in the variety trials on all district plots in conjunction with plant development records.

The mature crop was analysed for bollworm and stainer damage

Jassid (Empoasca spp.).—This pest only appeared in negligible numbers during the season.

American bollworm (Heliothis armigera).—Only on two plots, those at Mgera and Kingolwira Village, could this pest be said to be serious in its occurrence and even then it did not compare with the intensity of the attack in 1944. Ilonga had a mild infestation, a peak of 1,700 larvæ per acre comparing with 10,000 in 1944.

Shedding.—Mass collections of shed buds and bolls were made on the district plots. These showed that loss due to bollworm varied from 12–36 per cent. of the total.

At Ilonga as in the previous season all flowers on 200 plants in a bulk of Local were tagged. All sheds were collected and analysed for damage as were also the final open bolls.

The figures were :—

Total flowers set	4,362
Total flowers and bolls shed	2,943

Of this total shed, 39 per cent. was due to bollworm.

The mature bolls were examined lock by lock, damage being classified into :—(i) Completely destroyed by bollworm ; (ii) Completely destroyed by stainers ; (iii) Grade III due to stainer, bollworm and *Helopeltis*.

Including shed bolls and flowers the final figures are as follows :— They are given as percentages of the total flowers tagged.

Grade I cotton	18·3
Total loss due to bollworm	29·1
Total loss due to stainer	19·8
Total loss due to other causes	26·1
Grade III cotton	5·6
Unaccounted for	1·1
	100·0

The loss due to bollworm was practically the same as in 1944 although the American bollworm population was about one quarter of that recorded in the similar bulk used in the previous season at its peak. This was undoubtedly due to the large population of Spiny bollworm and the fact that Pink bollworm was also present as from the commencement of flowering. The amount lost due to other causes was much higher than in 1944.

Pink bollworm (Platyedra gossypiella).—This appeared in quite large numbers very early in the season. It was thought to be due to regrowth of cotton which had not been properly cut out, favoured also by the early rains in November and December 1944. On Ilonga an early bulk of Local planted in February was carrying quite a large population by the middle of April. At the time it was thought that this was a purely local occurrence due to inefficient uprooting on a nearby estate. As a result it was decided to cut out this bulk in order to prevent interference by Pink bollworm with the breeding material. It was later found however, that the attack was general throughout Kilosa and Morogoro districts. It varied very considerably in numbers over the district plots, but only on the plot at Mkundi did any considerable breeding take place. The uprooting date was put forward by one month to October 31st in order to increase the period of the close season in the Morogoro and Kilosa districts.

Spiny bollworm (Earias spp.).—This was present throughout the season in all plots in quite large numbers, and must have caused considerable loss of crop.

Stainers (Dysdercus spp.).—The same four were recorded as previously. *D. intermedius, D. fasciatus, D. nigrofasciatus* and *D. cardinalis*.

The most important of these was *D. intermedius* which occurred in very large numbers on most of the plots, reaching the enormous peak figures of 14,750 and 10,200 per acre at Mkundi and Morogoro respectively. *D. fasciatus* was recorded in some numbers at Morogoro and Kingolwira Farm.

D. nigrofasciatus was observed only in small quantities while *D. cardinalis* was negligible. Much larger numbers of stainers were recorded on M.U.8A than on Eastern Province Local in practically all the trials. These differences in populations were significant in three cases.

The damage caused by *D. intermedius* was very severe on all district plots the amount of stained Grade III cotton picked ranging from 77 per cent. of the total yield at Kingolwira Farm to 88 per cent. at Mkundi. For an unknown reason stainer population on Ilonga commenced to drop at the beginning of July with the result that much of the crop was clean, the boll census showing only 35 per cent. of stained cotton.

Calidea spp.—Only occasional individuals were observed.

Helopeltis spp.—This pest occurred in varying numbers on most of the district plots, the three plots most seriously affected being Morogoro, Mkundi and Mgera. Numbers recorded were not large, never exceeding 350 per acre, although as the insect is so active the records cannot be said to be very accurate. It persisted in the crop throughout the season causing severe damage to bolls. Late-planted native cotton, particularly in Kilosa district, was in a number of cases completely destroyed by damage to the plant body.

Capsid (Lygus spp.).—Damage caused by this pest was observed early in the season on some plots, particularly at Morogoro. It did not appear later in the season.

SUMMARY.

The season was the worst one since recording started in 1941. While American bollworm did not appear in quantity, stainers, *Helopeltis*, spiny bollworm and pink bollworm all contrived to make the crop one of the lowest on record.

The ability of the very productive type M.U.8A to make a crop even in the face of an insect pest attack such as this was again demonstrated.

PROGRAMME OF EXPERIMENTAL WORK, 1946.

The selection and testing work will be carried on. Future insect work is at present under discussion.

NYASALAND.

COTTON EXPERIMENT STATIONS.

Introductory Note

BY

H. C. DUCKER.

District.	*Elevation.*	*Types of Crop.*	*Months in which :*		*Legal Close Season.*
			Sown.	*Harvested.*	
Lower Shire } Lower River ... Chikwawa }	200–500	Semi-summer Winter	Jan.–Feb. Mar.–Apr.	July–Oct. Sept.–Oct.	Nov.–Dec.
Central Areas	1,000–2,500	Semi-summer Summer	Jan. Nov.–Dec.	July–Sept. May–Aug.	Oct.–Nov.
North Nyasa : Karonga Lake shore areas only	1,600	Winter	Mar.–May	Sept.–Dec.	Jan.–Feb.

Note.—Close seasons in Nyasaland may be modified in future to accord with the entomological findings, when Government has decided what action to take with regard to Lower River areas. In 1945 owing to the large amount of crop in sight in the field the uprooting date was put forward from 31st October to 10th November. Although seed is not issued from stores until 28th December the first rains, which usually fall towards the end of November, cause fallen cotton seed to germinate. Efforts are made to secure the uprooting of all these self-sown plants, but some must go unnoticed in the large areas involved, so that the effective close season is actually less than the legal two months.

Preliminary surveys of the Shire Valley have been carried out during the 1946 dry season, following the decision of the Nyasaland Government to implement the report presented last year by the Corporation entomologists.

The surveyors were Professor Debenham of Cambridge University, who has re-examined the proposals made by Mr. Kanthack for a barrage across the Upper Shire and control of water flow down the Murchison Cataracts to the Lower River ; and Mr. Griffin, formerly Director of Irrigation in the Anglo-Egyptian Sudan, who has examined the problems presented by the Lower River.

Reports have not yet been published (September, 1946) : but whichever of the two regimes suggested for our major producing area is adopted by Government, it seems unlikely that any immediate changes in the agricultural circumstances of the Lower River are in prospect. If the river control and winter crop regime is adopted, de-watering of flooded areas and the establishment of irrigation and drainage facilities will take several years, while the summer crop alternative will need a cautious approach in view of the agronomic problems involved.

It has been suggested by Mr. J. B. Hutchinson, who visited Nyasaland during May, 1946, that if the summer crop regime must be adopted, it should be tried out on a small scale first in some isolated area, a possibility which had been envisaged by Mr. Pearson. The Lower Mwanza valley, to the northwest of the Lower River, may be suitable.

No basic changes have, therefore, occurred in the general agricultural circumstances of the Lower River area since the 1944/45 report was written, but a further rise in the price of seed cotton, authorised for the 1946 markets, may serve as an encouragement to the growers, who are reported to have a good late crop.

In the Central areas, where it had been hoped that some improvement would occur during the current year, tobacco prices have boomed to levels amounting to increases of 100 per cent. on 1945 values. It is feared that not only will this result in a further set-back to cotton production, but that even the planting of food crops may be endangered, and warnings have been issued to guard against the latter contingency.

Difficult planting conditions due to a short-fall in the early rains have not only made the 1946 Lower River crop one of the latest on record, but have done much to off-set the increased distribution of sowing seed made in the Central areas, where it is considered, however, that the cotton crop will show an improvement on the 1945 production.

In North Nyasa the winter crop is reported to be well established, and it is to be hoped that a good harvest will be reaped. 1945 produced a record yield for this small area (419 tons seed cotton).

Both N.17 and B.P.52, which were tried out in North Nyasa last year, gave excellent results in the field, and spinning test reports received recently show that our winter crop is capable of equalling the best Uganda standards of quality and even surpassing them in the case of N.17. The Nyasaland version of the latter derives from a stock re-selected for some years at the Domira Bay Station, mainly for jassid resistance.

Government is arranging the development of a small area of typical floodland, conveniently near to Karonga, as a district experimental station where problems of wet season rice and dry season (winter crop) cotton may be investigated. This station will provide facilities for cotton work in North Nyasa which have hitherto been lacking and provide moreover some advance information which may be applied in the Lower River, if a winter crop regime is ultimately adopted in the latter area.

At Domira Bay work on the problems of summer crop cotton has continued on familiar lines. Derivatives from Mz.561 and C.L.20 continue to be possible substitutes for the present commercial Crown Land bulk U.4 mixture.

The blackarm and wilt resistant Uganda cotton B.181 has lived up to the promise it gave last year of suiting our conditions, and a range of very promising re-selections has been made, also new crosses between it and our leading strains and varieties.

The quality crosses obtained from Barberton have proved disappointing in the field, and only one, the green fuzzed derivative

from A.2208, M.U.8 × U.4 cross, is being carried forward for trial in 1946/47. This derivative showed much more vigour than its fellows, and appears to contain some good quality lint.

B.P.52 from Uganda may prove a source of useful material for this country, especially in its blackarm-resistant versions, one of which has been kindly supplied by J. D. Jameson of Kawanda. A range of re-selections has been taken from the bulks obtained in 1944 from Uganda and Barberton. It is not thought, however, that this variety in its present form is suitable for summer crop conditions in Nyasaland. In 1946 it has been decisively out-yielded by all other strains with which it has been compared, both at Domira Bay and elsewhere in the S.W. Lake shore areas.

Apart from the return of Mr. S. T. Hoyle to the Station in March, 1946, after release from his war-time employment as Agricultural Officer, there have been no staff changes during the year.

DOMIRA BAY STATION.

PROGRESS REPORT, 1945-46.

BY

H. C. DUCKER, S. T. HOYLE AND W. L. MILLER.

General Survey of the Season and of the Experimental Work; and Conclusions.

Meteorology.

The total rainfall for the season was 33·63 ins. (the 15-year average is 33·15 ins.) but the distribution was far from good, and scrappy rains at planting time were a source of much anxiety. Fortunately the weather during January and February proved ideal for growth and not only enabled lee-way to be made up, but put the crops in good shape to withstand the ill effects of a very wet spell about the middle of March. The native-grown crops in this area suffered far more than did those of the experiment station, an outcome mainly of the unsystematic agriculture of the African, and similar reports were received from other parts of the country. The commercial trials of Mz.561 and C.L.20 bulks were particularly hard hit by the poor planting season.

The meteorological records kept at this Station have proved valuable to a number of interests and in July, 1946, it was arranged that they be sent regularly to the Director of Meteorological Services, Salisbury, to form part of a general recording scheme for Central

Africa. It is intended that they shall be used, not only for general purposes, but also to assist in forecasting weather on the Lake, a matter the importance of which has been emphasised by the recent tragic loss of the new Lake vessel *M.V. Vipya.*

Agriculture.

The first planting rain came on 30th December, about 10 days later than normal, and the difficult planting conditions which ensued resulted in a shorter growing season than usual, and bulk cotton yields were lower than in 1945. Large bulks were grown of the Mz.561 derivative, T.22, and the two best yielding re-selections from C.L.20, Nos. 34 and 46. The T.22 bulk yielded 206 lb. lint per acre and C.L.20-46 243 lb. lint per acre. The C.L.20-34 was grown on new land which became water-logged and its much lower yield of 180 lb. lint was due to soil conditions rather than lower yielding capacity. B.181 was sown at a low seed rate on ten acres and yielded 213 lb. lint per acre from quite a poor stand.

Maintenance of fertility.—Various aspects of this problem, especially with a view to securing maximum fertility with minimum effort, continue to be investigated in a number of long-term experiments. Two of these were test-cropped with cotton and, though no significant differences were obtained, the negative results are of some interest. Both experiments will be cropped with maize in the coming season.

The object of the first experiment was to find out if there was any virtue in adding a legume to the elephant grass resting cover. One set of plots had velvet beans planted among the elephant grass while the other was pure elephant grass. The field was left untouched for three seasons and a small amount of re-seeding of the velvet beans took place each year. The small difference between the yields of cotton was not significant so that for this crop, at least, the extra work of planting velvet beans has not been worth while. The second experiment compared the results of three years rest under (1) elephant grass, (2) pigeon peas, (3) chance weeds and (4) perennial sorghum. The comparison of the last two with elephant grass is of especial interest as being most likely to appeal to the African as no work is involved in establishing a chance weed cover and sorghum provides a good food supply. It seems highly improbable that a crop of sorghum which is known to be exhaustive when grown as an annual, can restore fertility to the same degree that elephant grass does. Nevertheless both these treatments gave 300 lb. lint per acre, the yield after chance weeds was slightly, but not significantly greater and the yield after pigeon peas least of all. The yield of sorghum during the three years was low and an invasion of Cynodon grass into the field may have helped to obscure treatment differences. It is a common practice on the lake shore to plant sorghum on maize fields where the yields have become very low. The plants are ratooned after harvest and gaps supplied the following rains. After three or

four years of this treatment the field is often abandoned to bush, but the growers aver that good yields of maize can again be obtained.

It is of interest to record that 25 acres of the local strain of elephant grass were cleared without difficulty using hand labour only. This was the first break in the main rotation to complete its full four years rest under this cover. These fields were burned over in the previous year and the considerable re-growth was cut down in March. The trash was heaped in windrows at right angles to the ridges in order to equalise the beneficial effect of the burning on the subsequent crop. The land was then dug and only a small amount of further re-growth took place during the dry season. Considerably greater work was involved on 10 acres where burning the previous year had been omitted. There was more work in cutting down the grass in March and the large cut stems caused numerous cuts and wounds among the workers, digging was harder and the subsequent re-growth much greater. There is no doubt that under Nyasaland conditions a preliminary burn is required to make the clearing of elephant grass a practical proposition.

Cultural practices.—The practice of minimum pre-cultivation of lands which have carried a hoed crop in the preceding year is being maintained and nothing in 1946 experience has suggested that it may be unsound. Lands left untouched after harvest become covered with "Winter Weed," *Trichodesma zeylanicum*, and other herbage and this means the Station has an untidy appearance from then till the time for new season preparation. The soil cover thus maintained is possibly of value on old cotton fields by reducing the high soil temperatures which inhibit the emergence of resting Red bollworm pupae. Cotton bushes are burned as soon as dried after up-rooting to comply with crop sanitation regulations. Minimum pre-cultivation has been carried a step further this year by leaving crop residues on the lands after harvest for as long as possible. In the case of fields intersown with rest crops we have not bothered to up-root the maize nurse crop after harvest this year. This further adds to the untidy appearance of the Station, but indications are that labour spent on uprooting and laying dead maize stalks is merely wasted.

No new experiments in pre-cultivation have been done this season, but several are being planned with especial reference to possible mechanisation of our dry season cultivation. The plots used for the "digging" experiment with cotton reported last year were sown with maize to investigate residual effects. Last year there were significant increases in cotton yield for "no digging" but with maize this year the order was reversed as follows :—

	Yield lb. grain per acre.
No digging	2,580
Normal digging	2,650
Deep digging	2,820

These differences just failed to reach the level of significance with a value for P of ·056. But even a significant difference of the order of 240 lb. maize per acre would not justify the considerable extra work entailed in deep digging. Such differences are only worth while where there is acute pressure on the land. If land is available it is cheaper, either in terms of money or effort, to cultivate a larger acreage.

Mixed cropping.—Previous trials of planting maize and cotton together have shown that, in the Central areas, satisfactory yields can only be obtained when cotton is grown as a pure stand summer crop. In the Lower River, on the other hand, the bulk of the cotton is inter-planted among maize. The success of this practice is due to the long growing season which enables cotton to be planted weeks, or even months, after the maize and to continue growing after the maize has been harvested. The African cotton growers of the Central areas have learned about this practice and numerous gardens are so planted each year. If there is a high proportion of maize the inevitable result is a very low yield of cotton. Nevertheless the attraction of securing some cash while working on the essential food crop is so strong that it was thought worth while to start further experiments. The object of these experiments is to devise a method of inter-planting maize and cotton in such a way that there will be a fair yield of maize and (high yields being impossible) a reasonable cash return. If successful, these experiments may induce some Africans to plant cotton who would not otherwise do so. This year's experiment was of an exploratory nature with a wide range of maize/cotton ratios.

MAIZE.			*COTTON.*		
% No. of holes.	*Yield.*		*% No. of holes.*	*Yield*	
	lb./acre.	*%*		*lb./acre.*	*%*
nil	—	—	100	233	100
12·5	414	34·4	87·5	192	82·2
16·6	520	43·5	83·4	170	73·8
25·0	702	58·5	75·0	143	61·6
33·3	970	80·9	66·7	109	46·9
50·0	1,200	100·0	50·0	59·5	25·9

These results show clearly that while maize yields are compensated to some extent by the wider spacing, cotton yields are greatly reduced by the competition. The experiment in the coming season will consist of arrangements with maize rows spaced widely apart but closely planted in the row.

Rotation Crops.

Maize.—The late start to the season caused the yields to be rather lower than usual. The white maize selection averaged 1,848 lb. per acre over 22½ acres and the yellow 973 lb. per acre over 10 acres. The low yield of the latter was largely due to depredations by baboons. In a strain trial there was no significant difference in the yields of white maize at 2,239 lb. per acre and the yellow maize at 2,120 lb. per acre.

It does not appear, from recent communications by the medical authorities, that there is any special virtue in yellow maize from a dietary point of view, since a small amount of green food supplies ample carotene (vitamin A) to replace that missing from white maize. Since the Africans definitely prefer the latter, and the yields seem to be in its favour, no further work will be done on local yellow maize.

Groundnuts.—Average yields were good, being only slightly less than in the record year of 1943. A number of varieties have been grown in acre plots for the last six years and the results are summarised below.

Variety.	*6 year average lb. shelled nuts per acre.*
Santa Fé	1,115
Manyema	1,110
Barberton	1,020
Gambia	1,055
Spanish Bunch	980
Mwitunde	903
Cordoba	873
Virginia Bunch	875
Senegal	707

Although not grown in randomised plots the above results have been examined statistically using the years as " blocks " and a difference of 201 lb. per acre is found to be significant. In addition to the above, Japanese has been grown for two years and two local runner varieties, Chimbuwila and Kalisele ; these averaged 1,035, 650 and 605 lb. per acre respectively.

The above figures clearly show the advantage to be gained by growing a bunch type. The collection of varieties is to be discontinued and only bulk plantings of Gambia and Mwitunde will be made in future. Gambia has been chosen because, besides its high yield, it is easy and cheap to handle. The small seeded Manyema and Santa Fé entail a good deal of extra work at harvest, and there is more precocious sprouting in the field with Cordoba, Virginia and Spanish Bunch. Mwitunde, a semi-bunch variety, has also been chosen because it is rather later in maturing and so lengthens the harvesting period which eases labour problems when 20-30 acres are being grown.

In spite of the fact that bunch varieties give a higher yield and are easier to harvest, the African prefers the local runner types. It is less laborious to dig a bunch type when there is moisture in the ground, but it must be dug at the right time and over a limited period of time. The more leisurely harvest which is possible with the runner types seems to be the controlling factor in the African's preference for these lower yielding types.

Pigeon Peas.—There are no special notes to be recorded on this crop, which continues in use, planted with elephant grass, as the standard rest crop on the Station.

Tanks and Dams.

The experimental programme, in so far as construction is concerned, should have been completed this year, but labour shortage has necessitated holding over the final work till next season. Three dams are completed and two have been filled twice. A fourth dam is about two-thirds made and a fifth, a tank-dam, about half made. Temporary spillways will serve the two incomplete dams this coming rains and protect them from damage. A start has been made in vegetable growing during the dry season below the first made dam with promising results, and there is already evidence that seepage losses are becoming less from this dam. At the time of writing the level of water is 10 inches higher than at the same time last year but it is likely to dry up completely before the first rains.

Cotton Breeding.

Variety Trials.—Trials were carried out at the same places as in 1945, two in the Central areas and three on the Lower River. In the first two trials at the Station and at Sharpevale, T.22 was out-yielded by the Crown Land bulk derivatives, and it seems probable that it and the C.L.20 stocks are not in their present guise intrinsically heavier croppers than the commercial Crown Land U.4 bulk. This variety is still capable of heavy yields when given good agricultural conditions with freedom from insect pests. Yield and ginning figures for the two Central areas trials were as follows :—

Variety.	*Cotton Station.*		*Sharpevale.*	
	lb. lint per acre.	*Roller G.O.T.*	*lb. lint per acre.*	*Roller G.O.T.*
C.L.20–30	263	36·7	—	—
C.L.20–34	251	36·9	304	33·9
C.L.20–46	269	37·7	298	34·7
C.L. Bulk (Chiromo)	—	—	302	33·6
B.181	237	35·4	244	33·2
T.22	234	34·0	223	31·8
B.P.52	164	34·3	180	33·0
Sig.diff (P= .05)	18	—	29	—

The failure of B.P.52, as a summer crop cotton, to produce yields comparable with local stocks is very evident in the above figures. This long stapled variety was also grown in a 5-acre bulk and yielded 162 lb. lint per acre. The lower ginning out-turn at Sharpevale compared with that from the same varieties grown at the Station is noteworthy, and is not due to machine differences as the same roller gin was used for both lots. Ecologically there is no great dissimilarity between Sharpevale and Chitala, but the better soil conditions at the former appear to have resulted in slightly larger yields and higher seed weights.

The results for the 1946 trials on the Lower River have not been received, but the figures for the 1945 Chikwawa trial, which arrived too late for last year's report, are given together with the Sharpevale figures for comparison. Two other trials, at Port Herald and Chiromo, were invalidated by excessive pest damage ; the former averaged 98 lb. lint per acre, half of which was badly stained, and the latter

26 lb. lint per acre, all of which was badly stained. Until the insect pest position is improved it is not likely that trials in this area will give results of any value.

Variety.	Yield, lb. lint per acre. Sharpevale.	Chikwawa.
N.C.4	310	133
C.L. Bulk, Chiromo	280	131
C.L. Bulk. Chikwawa	278	136
N.C.7	280	126
A.2208	275	126
Mz.561	186	101
Sig.diff (P= .05)	47	16

Owing to lack of facilities no district variety trial can yet be arranged in North Nyasa, where the winter crop last year was a local record. The Department of Agriculture is opening a new experimental area and it is hoped to arrange trials there next year. An observation plot of B.P.52 was grown on flood land near Karonga with results which are reported to have been quite good, and a fairly large quasi-commercial trial of locally selected N.17 cotton was grown on a private estate. Neither yield per acre nor acreage are available, but the estate owner says he was very pleased with the performance of the cotton. Lint samples of both varieties have been spun by the B.C.I.R.A. with very satisfactory results.

Breeding material.—The Station material was examined this year by Mr. J. B. Hutchinson and, acting on his advice, an attempt is being made to sift our present range of strains in large bulk and to eliminate all but the outstanding ones. To this end a total of about 1,500 single-plant selections have been taken from T.22, C.L.20-20, C.L.20-34, C.L.20-46 and the two Uganda varieties, B.181 and B.P.52.

T.22.—Re-selections were made in 25 progeny rows, the lint from which was sent by air to the Shirley Institute for small-scale spinning tests. The results of this test showed that there were five progeny rows giving lint well up to the standard required in Nyasaland and re-selections from these rows only will be planted in the coming season.

C.L.20.—The original C.L.20 stock gave an excellent performance and, since it has obviously been splitting during the past three years for many field characters, it is hoped that the lint characters which govern its quality may be sorted by intensive re-selection. As a cropper under Nyasaland summer crop conditions it is in the first flight with the commercial Crown Land bulk from which it was selected. C.L.20–30, –34 and –46 are the best yielders and –20 the best spinner. Mr. Jameson has very kindly tested C.L.20 stocks for blackarm resistance, and in a recent letter he says that C.L.20–20 is probably resistant. Unfortunately this cotton was not included in the main strain trial of 1946. C.L.20–34 and –46 are undoubtedly mixed for blackarm resistance factors, and an attempt will be made to sort out the resistant and susceptible lines.

B.181.—This Uganda variety shows considerable promise under Nyasaland conditions and has not only given a good performance in the field but has also provided some of the best spinning material. It has many good qualities including low hair weight, B_2 resistance to blackarm and wilt resistance and it has been used as a parent in making crosses. It is very mixed, especially for lint length, and considerable improvement is hoped for with re-selection.

B.P. 52.—This variety has not shown promise under summer crop conditions, but some selections have been made with a view to trial in winter crop areas.

Crosses.—The field performance of the Barberton "quality" crosses has been disappointing for the second year in succession, and in view of more pressing commitments, work on these has been suspended. Only one, the green-seeded derivative from A.2208, a cross between U.4 (8161) and M.U.8 (Malwa Upland), compared at all well with our main varieties. Twenty-five single plant selections from it are being carried forward to the next season.

New crosses have been made between B.181 and T.22, C.L.20 Nos. 20, 34, 46 and 66, P.B.52, A.250 and B.P.50 x B.181. The last of these being a cross made by Mr. Jameson in Uganda.

Mr. Hutchinson has proposed a co-operative breeding experiment which will enable work at this Station to be linked up with work at Shambat in the Sudan and elsewhere. To this end a number of crosses he is making in the Sudan will be studied at both Stations and parallel cultures maintained. Among the parents selected is H.K.2, the heaviest yielding cotton yet selected in Nyasaland. This cotton does not spin nearly as well as its hair characters would indicate. It derives from the U.4 x Cambodia x U.4 crosses made by Dr. Harland in Trindad and sent to Africa.

Spinning tests.—The following table gives a summary of the more interesting results from the 1945 crop together with the small-scale spinning test results from progeny rows of T.22 grown in 1946.

Variety.	*Place Grown.*	*Effective Length, 32nds.*	*Corrected Lea Product, 40's.*	*Standard Fibre Weight.*
Commercial crop ...	Lower River. Mitole ...	32	1,715	217
	" " Maperera ...	33	1,777	222
	" " Muona ...	34	2,099	212
	" " Ngabu ...	34	1,899	214
	Karonga ...	38	2,254	197
C.L. Bulk	Station trial ...	34	1,959	217
Mz. 561	" " ...	37	1,961	206
T.22	" " ...	33	2,036	209
C.L. 20/20	" " ...	37	2,094	177
C.L. 20/34	" " ...	36	1,797	170
C.L. 20/46	" " ...	37	1,822	188
A. 2208	" " ...	33	1,815	182
B.P. 52	" " ...	38	2,217	155
B. 181	Single plot. Cot. Station ...	35	2,264	159
B.P. 52	" " Karonga ...	38	2,456	152
N. 17	" " Karonga ...	38	2,428	187
T. 22.6	Progeny Row. Cot. Station ...	40	2,299	183
T. 22.12	" " " " ...	39	2,276	173
T. 22.16	" " " " ...	40	2,311	185
T. 22.20	" " " " ...	40	2,244	192

It is noticeable that the winter crop at Karonga produces the strongest yarn, not only from the observation plots of long stapled varieties, but also from the commercial crop. Figures published for B.P.52 and N.17 when grown in Uganda compared with the figures for these varieties grown at Karonga show that effective lengths are a little less, maturity a little better, standard hair weights about the same and Lea products at 40's a little higher. It would therefore seem possible to produce cotton of Uganda quality as a winter crop in Nyasaland but, until yield trials have been conducted, it cannot be said if it would be an economic proposition.

The poor quality of the lint from the Mitole and Maperera areas of the Lower River is causing some concern. It has now been shown that it is not due to seed supply and is presumably due to soil, climate, insect pests or a combination of all three. Investigations are now taking place to determine the cause of the trouble.

Pests and Diseases.

Flower tagging was again duplicated in fields at either end of the main cotton acreage, in field 35, old clearing sown with T.22 bulk, and in field 60, new clearing sown with C.L.20–30 bulk. A random plot layout ten times replicated, the individual plots of 5 perfect holes x 3 plants, was used as in 1945. The summarised results were as follows :—

	Field 35. *T.22.*		*Field* 60. *C.L.20-30.*	
	No.	*Per cent.*	*No.*	*Per cent.*
Flower Production	4,199	100	3,635	100
Bollworm Sheddings	226	5·7	243	6·8
Non-bollworm Loss	2,708	64·3	2,307	63·3
Ripe Bolls	1,058	25·2	959	26·4
Tags Lost	207	4·8	126	3·5

As is usual at the Station the bulk of the crop was made during the second half of March, but the heavy rains received that month, over 12 inches, allowed effective flowering to continue for rather longer than is usual. No flowering after 27th April in field 35, or 1st May in field 60 resulted in ripe bolls. Bollworm sheddings at about 6 per cent. of the total flowers were rather less than the usual figure of 9–10 per cent. This was probably due to dilution of the carry-over moths as the area under cotton was about 45 per cent. greater than in 1945.

Blackarm.—It had been hoped to continue blackarm studies this season, but the lateness of the crop made the collection of infected leaf material impossible before March was well advanced. A good stock of material was then collected and dried, and is in store awaiting the 1946–47 crop. There is circumstantial evidence which suggests that the non-bollworm loss is bound up to some extent with susceptibility to blackarm attack, and it is hoped to investigate this with resistant and susceptible types of the same parentage. It may be noted that T.22 and C.L.20–30 are heterogeneous for blackarm resistance and the non-bollworm losses in the tagging experiment were nearly

identical. It is not thought, however, that any of our present stocks except B.P.52 are pure susceptibles. Blackarm does not appear to be quite so important a limiting factor in Nyasaland as it is in countries to the north, though exact proof of this is lacking till we can compare in variety trials resistant and susceptible stocks of the same parentage.

Summary of Main Conclusions.

1. It is proving difficult to better the commercial Crown Land Bulk U.4 in yield per acre, but the lint of certain possible substitutes shows some advance in spinning quality.
2. Red bollworm control, allowing for the increased area sown to cotton this season, has been maintained at its usual level.
3. The most hopeful line of attack on yield problems is to reduce the non-bollworm loss. A reduction of about 13 per cent. in this would result in an increase of crop of the order of 50 per cent.
4. Rest cropping experiments continue to suggest that fertility may be maintained thereby, and that means well within the powers of the African can be devised for putting this practice into effect.
5. Mixed-cropping under summer conditions can only be done at the expense of cotton yields.
6. The performance of C.L.20–20 and B.181 suggests that resistance to blackarm may assist in the improvement of quality, though it is still doubtful if yield under Nyasaland conditions will always be affected by the use of resistant types. Further work is required.
7. Mz.561 is not living up to its early promise on this Station as far as yield is concerned. B.P.52 is definitely inferior in yield under summer crop conditions in Nyasaland.

PROGRAMME OF EXPERIMENTS, SEASON 1946 - 47.

Variety trials.—The Station and District trials will be continued. At the Station the trial will be repeated with different times of planting as much of the commercial crop is planted much later than it should be. The progeny row bulks of T.22 will be planted in a separate trial.

Selection.—Work will be continued in the T.22, C.L.20 and B.181 stocks.

Hybridization.—Work will be started on the crosses made locally and those made by Mr. Hutchinson at Shambat.

Mixed-cropping.—An experiment to find out a practicable method of planting maize and cotton in the same field will be laid down.

Blackarm.—Studies on the resistance factors contained in local stocks will be commenced.

Maintenance of fertility.—The present range of experiments will be continued. A new experiment, comparing various resting techniques more suitable to African agricultural methods than the planting of elephant grass, to be begun on a field due to be rested. A new experiment, suggested by the Director of Agriculture, comparing stubble mulching with present Station practice to be begun on a field which has been resting under elephant grass for four years.

Soil Structure.—Studies to be commenced.

[*Included by courtesy of the Nigerian Government.*]

NIGERIA.

PROGRESS REPORT ON COTTON GROWING IN THE NORTHERN PROVINCES FOR THE SEASON 1945-46.

Normal Planting dates... ... ... Mid-June to end of July.
Normal Picking dates ... ... December to February.

RAINFALL.

January	Nil.	April	0·60 ins.	July... ...	9·32 ins.	October ...	2·10 ins.
February	„	May	1·64 „	August ...	12·70 „	November	Nil
March	„	June	6·32 „	September ...	8·58 „	December ...	„

Total for 1945... 41·26 ins.

Introduction.

There were no new introductions during the year besides the native cottons which were grown for observation purposes and for valuation and analysis at Shirley Institute. Rainfall for the year was satisfactory.

Conclusions from the Season's Work.

Four trials were carried out, one at Daudawa and three on the Botanist's Farm, Samaru. The objects and results appear below.

The strain " Samaru 26c " was sown for the first time in *Stage 1* of the Daudawa multiplication scheme. The direct descent of this strain is D31–D5–A26–26–26c, selection each year being a single plant.

In trials with Commercial Allen from Funtua Ginnery as control the following results have been obtained. Those in 1939 and 1944 are strictly comparable trials but the 1942 results are from similar adjacent plots.

	1939		1942		1944	
	26c	*Allen*	*26c*	*Allen*	*26c*	*Allen*
Yield Lint p.a.	202	127	231	114	236	179
Gin %	38·3	31·4	39·8	31·0	32·5	28·6
% Increase (lint) ...	60	—	103	—	32	—
Mean Length	28	26	25	26	27	23
Effective Length... ...	38	36	37	38	38	36
Percentage Dispersion ...	28	25	29	27	26	32
Percentage Short ...	21	32	31	31	31	36
Percentage Normal ...	61	52	43	48	49	36
Percentage Dead... ...	12	19	15	14	19	24
Mean Hair wt.	208	183	183	169	201	183
High St. Count	41	43	50	50	32	36
Count strength 32's ...	2,148	2,243	—	—	—	—
Count strength 40's ..	2,045	2,075	2,162	2,180	1,894	1,901
Value points	+125	+110	+25	0	0	+10

Experiment W1 (45).

A variety trial at Daudawa. Latin Square with seven replications and plots 1/40 acre each. Spacing was 15 ins. on ridges 2½ feet apart. Sown July. No manure. The strains were :—

(*a*) Daudawa 43 ; (*b*) Daudawa 44 ; (*c*) Daudawa 45 (= 26c) ; (*d*) B.C.G.A. ex Mai Inchi Ginnery ; (*e*) B.C.G.A. ex Gusau Ginnery ; (*f*) B.C.G.A. ex Zaria ; (*g*) B.C.G.A. ex Funtua.

In strains *a*, *b*, *c*, the figures following " Daudawa " refer to the year in which the strain was grown in *Stage I* of the Daudawa seed multiplication scheme. Daudawa 45 is our selection called " Samaru 26c." Daudawa 43 and 44 were mixtures of our selected pure lines.

Results in Seed Cotton.

The differences in seed cotton were not significant and the yields were as follows :—

	Lb. seed-cotton per acre.	*Ginning %*
B.C.G.A. ex Mai Inchi	422·60	27·81
„ „ Funtua	408·38	28·94
„ „ Gusau	392·91	27·99
Daudawa 44	392·22	34·11
B.C.G.A. ex Zaria	389·02	29·20
Daudawa 43	378·40	33·67
„ 45	349·11	34·77

Lint.

Differences in lint were also insignificant. The yields were :—

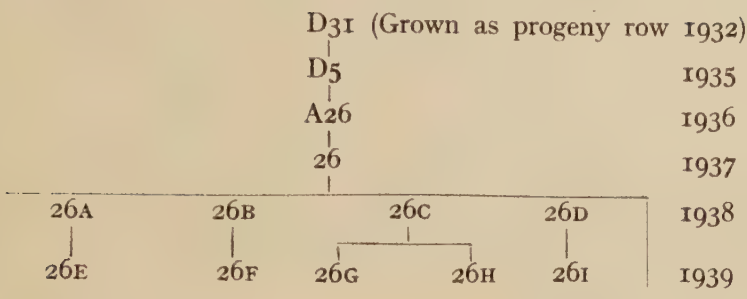
	Lb. lint per acre.	*% B.C.G.A. ex Gusau.*
Daudawa 44	133·84	121·64
„ 43	127·39	115·78
„ 45	121·39	110·32
B.C.G.A. ex Funtua	118·19	107·42
„ „ Mai Inchi	117·45	106·74
„ „ Zaria	113·57	103·22
„ „ Gusau	110·03	100·00

Experiment A11 (45).

Cotton variety trial at Samaru. Balanced lattice, nine varieties and four replications. Each plot = 1/110 acre. Plants 15 in. on 3 ft. ridges. No manure. Sown in July. The strains sown were :—

26c; 26e; 26f; 26g; 26h; 26i. ; N'kouala (an introduction from Belgian Congo) ; Oasis (an introduction from Belgian Congo) ; Commercial Allen ex Funtua.

The relationship of the " 26 " strains is as below :—



Results in Lint.

Strains.	Yield lb. per p.a.	% of Allen
26C	167·25	138·82
26I	159·14	132·21
26E	138·87	115·26
26H	136·29	113·12
Oasis	129·30	107·32
N'koula	123·72	102·69
Allen	120·59	100·00
26F	115·99	96·27
26G	101·23	84·02

Sig. diff. 5% = 25.516 = 19.2% G.M.
" " 1% = 35.163 = 26.5% "

26C was significantly better than Allen (P = 1%).
26I " " " " " (P = 5%).

The rest were not significantly better than Allen.

26F and 26G were poorer than Allen, but the yield differences were not significant.

Experiment A6 (45).

Cotton Potash Manurial Trial (Botanist's Farm). Split plots with three main blocks. Size of main plots = 4/55 acre. Size of sub-plots = 1/55 acre. Spacing—15 in. on 3 ft. ridge.

Treatments.—Main plots ... A = No manure.
B = 3 tons F.Y.M.

Sub-plots ... 1 = 20 lb. K_2O per acre.
2 = 60 " " " "
3 = 100 " " " "
4 = Nil.

Fertiliser used was muriate of potash with 45 per cent. K_2O.

Results in Lint. (Main effects.)

Treatment.	*Lb. per acre.*
3 tons F.Y.M.	250·6
0 ,, ...	245·2
60 lb. K_2O ,, ...	266·9
20 ,, ,, ...	244·2
100 ,, ,, ...	240·6
Nil	239·5

S.E. 1 main plot = 2·06 lb. = 11·5% of G.M.
S.E. 1 sub-plot = 0·62 lb. = 13·8% of G.M.
No treatments or interactions were significant.

*Experiment A*13 (45).

Mulching experiment to see whether mulching the land at the end of the rain would preserve the moisture content of the soil and so produce a higher yield of lint or improve quality by reducing immaturity. Elephant Grass was used for mulching.

Variety: B.C.G.A. Mass selected seed.

Layout: Randomised block 9 repetitions. Each plot = 1/10 acre.

Mulching was done on October 8th on the day following a shower of 1·04 in.

Results in Lint.

Mulched ... ... 226 lb. per acre.
Not mulched ... 218 ,, ,, ,,

Seed Cotton.

Mulched ... ... 718 lb. seed cotton per acre.
Not mulched ... 748 ,, ,, ,, ,, ,,

The mulched plots gave lower yield per acre of seed cotton but because of a higher ginning percentage their yield of lint was increased.

The ginning percentages were

Mulched ... 31·6%
Not mulched 29·4%

The differences were not significant, but it is possible that mulching was beneficial and did increase the maturity of the lint. Samples are being sent to the Shirley Institute for analysis and further information on this point will be available.

PROGRAMME OF WORK FOR 1946-47.

Throughout the war years work on cotton was limited by shortage of staff and therefore the policy has been to multiply tested strains and maintain those which have shown promise with a view to continuing the work on selection and hybridisation at the earliest opportunity.

Hybridisation work will be resumed in 1947, using those indigenous types for which good reports have been obtained during the past two years. Further selection and testing work will be continued with strain 26C and its near relatives.

The maintenance of progeny rows and the multiplication of improved strains at Samaru and Daudawa will be continued. The arrangements for the multiplication of seed after it leaves Daudawa have proved inadequate and improved arrangements will be made in 1947.

The cotton mulching trial at Samaru will be repeated and a trial will be carried out to test the effect on yield of topping plants at varying heights.

After the present season observation plots and cultivation trials will be carried out at Daudawa as this area is more typical of cotton-growing country than Samaru. Only selection and hybridisation work will be retained at Samaru.

The prevalence of Pink bollworm in the Zaria district is to be investigated. Present indications are that this insect is widely distributed in the Allen cotton belt, but is nowhere numerous.

PROGRESS REPORT ON WORK ON COTTON IN THE SOUTHERN PROVINCES FOR THE SEASON 1945-46.

Normal Planting dates ... ... First 3 weeks of July.

Normal Picking dates ... ... January to February.

Weather.

Planting was done in July, and with the wet conditions then obtaining, germination was excellent. Figures showing the rainfall during the critical months of growth were as follows compared with the previous five-year average :—

	1940-44.	*1945.*
July	5·21	6·93
August	2·42	4·09
September	7·23	5·07
October	5·48	12·55
Total	20·34	28·64

The rainfall was well distributed but October with 22 wet days and a total rainfall of 12·55 inches was the highest ever recorded for that month on Moor Plantation, and was probably responsible for the rank growth.

There were a few cases of *Helopeltis* attack but these were not severe. A number of plants which suffered from Leaf Curl were rogued as observed. Attack by Pink bollworm which was prevalent during 1944 was absent this season.

Results of the Season.

The eight strains of Ishan A selected in the previous season on lint characters were tested for yield in an experiment conducted on an 8 by 8 Latin Square. Each plot was 1/36 acre. Spacing 3 ft. on ridges 4 ft. apart.

Seed Cotton yields were as follows :—

A6s.	273 lb. per acre.	A2s.	237 lb. per acre.
A36.	267 ,, ,, ,,	A7s.	234 ,, ,, ,,
A16.	253 ,, ,, ,,	A12.	232 ,, ,, ,,
A12s.	247 ,, ,, ,,	A16s.	222 ,, ,, ,,

The statistical analysis of the experiment showed no significant differences among the strains tested. Generally, the growth of the plants was good ; the wet conditions prevailing from the time of planting till late in the season encouraged vegetative growth and probably affected the boll production both in size and number, resulting in a low yield of 245 lb. to the acre. Normally Ishan cotton is expected to produce a yield of about 400 lb. seed cotton per acre as a sole crop.

Strain A6s which led in yield under treatment separation was chosen for planting. Self-pollinated seeds of 16 single plants selected on vegetative vigour from this strain will be grown next season.

PROGRAMME OF WORK FOR 1946-47.

There has been no change in the programme of cotton breeding at Ibadan since Mr. Hutchinson outlined it several years ago.

Self-pollinated seeds of 16 single plants selected from among the best yielding strain of last season will be grown in progeny rows of 40 plants each. All plants to be selfed. The best 8 rows are to be chosen on the basis of halo length and ginning percentage.

A multiplication plot of about one acre is to be grown for seed. The balance of the seeds used for the selection plot will be used for sowing this plot.

It is proposed to carry out a survey at Ibadan to determine the effect of Pink bollworm on yield. Observations are being made on the resting stage of this insect and a search for parasites is in progress.

Laboratory tests indicate that *Helopeltis sanguineus* Popp. is readily killed by Gammexane ; it is hoped to carry out a field test with this poison.

[*Included by courtesy of the Government of the Leeward Islands.*]

WEST INDIES.

COTTON BREEDING STATION—MONTSERRAT.

PROGRESS REPORT FOR THE YEAR 1946

AND

PROGRAMME OF EXPERIMENTS FOR THE YEAR 1947.

BY

A. S. HARPER.

	Island Crop.	*Breeding Experiments.*
Normal Sowing Dates	1st March—31st May	1st March, 1946.
Normal Picking Dates...	July—October	Beginning of July to mid-August.
Legal Close Season	December, January, February ...	—

METEOROLOGY.

The rainfall for the year up to the end of October was low, the amount recorded at the Station being 48·54 inches. Distribution was unsatisfactory ; 3·38 inches fell in one day in April, and the amounts falling in May, June and July were below the requirements for normal growth of cotton. In other parts of the Island the rainfall was even less, being 30·56 inches for the same period at Bethel in the Windward side of the island and 38·73 inches at Brades in the north of the island. Distributions for the three stations from March to September are as follows :—

	Mar. Inches.	*April. Inches.*	*May. Inches.*	*June. Inches.*	*July. Inches.*	*Aug. Inches.*	*Sept. Inches.*
Cotton Breeding Station ...	2·63	9·40	3·24	2·54	3·80	6·60	7·41
Bethel	1·20	8·73	1·31	1·89	1·53	2·24	4·97
Brades	4·33	12·99	1·63	1·93	1·64	5·33	5·64

COTTON BREEDING WORK.

Main Breeding Trial.—This trial consisted of twenty progenies grown in non-replicated progeny rows. Ten of last year's progenies were retained, four belonging to family M.4213, four from family M.4208 and two from family M.4210. Two plants were selected from each of these progenies, giving twenty plants, each of which was used to plant a progeny.

Small Bulks Trial.—This trial consisted of bulks of ten selected progenies and was grown in eight randomised blocks.

Both trials were sown on March 1st. Weather was favourable at planting and good germination resulted. Artificial manures were applied to progeny rows and small bulks at the rate of 3 cwts. sulphate of ammonia, 3 cwts. superphosphate and 2 cwts. potash per acre. Aphis attack occurred in April and was rather prolonged. Boll shedding also occurred to a marked extent in June. Selfing of the progeny rows was carried out as usual and ripened bolls were observed opening earlier than usual.

A sample of unselfed cotton was picked from each progeny row for the determination of seed cotton characters, and selfed cotton was picked plant by plant. In the small bulks trial picking was done plot by plot. In the laboratory, data for various seed cotton characters in both progeny rows and small bulks were computed, and lint yield per plant in the progeny rows and per plot in the small bulks obtained.

Samples of the lint were drawn from each progeny and from various ecological areas in the commercial field for shipment to the Shirley Institute for hair and small-scale spinning tests and one large sample from the first multiplication area for large-scale spinning tests.

Data for seed cotton characters from the Main Breeding Trial are given in the following table.

Family.	1945. *Progeny.*	1946. *Progeny.*	*Lint per Boll.*	*Ginning per cent.*	*Seed Weight per 100 seeds.*	*Lint Index.*	*Lint Length.*
			gms.		*gms.*	*gms.*	*mms.*
	M.4508	M.4601	1·03	29·9	14·34	6·12	52·5
	M.4508	M.4602	1·04	29·2	14·71	6·07	54·6
	M.4509	M.4603	1·02	28·7	14·34	5·77	54·2
M.4208 ...	M.4509	M.4604	1·08	29·1	14·08	5·78	51·2
	M.4510	M.4605	1·13	29·6	14·83	6·23	53·2
	M.4510	M.4606	1·17	29·3	14·56	6·03	50·2
	M.4511	M.4607	1·11	28·8	14·61	5·92	52·2
	M.4511	M.4608	1·11	29·3	14·85	6·21	51·8
	M.4513	M.4609	1·15	30·0	14·24	6·10	51·8
M.4210 ...	M.4513	M.4610	1·13	29·1	14·57	5·98	54·0
	M.4514	M.4611	1·13	29·6	14·32	6·02	54·2
	M.4514	M.4612	1·11	28·7	14·30	5·76	51·0
	M.4517	M.4613	1·15	28·7	14·30	5·76	51·0
	M.4517	M.4614	1·14	29·9	14·27	6·09	54·0
	M.4518	M.4615	1·16	30·0	13·84	5·93	51·8
M.4213 ...	M.4518	M.4616	1·05	29·5	13·87	5·80	54·4
	M.4519	M.4617	0·99	29·1	13·80	5·66	53·8
	M.4519	M.4618	1·10	29·6	13·63	5·73	52·4
	M.4520	M.4619	1·09	29·3	13·59	5·63	53·2
	M.4520	M.4620	0·83	28·1	13·52	5·28	53·0
		Means	1·09	29·2	14·23	5·90	52·7

Differences are small; with the exception of progeny M.4620, differences in lint index range from 5·63 to 6·23, in seed weight from 13·59 to 14·85, in ginning outturn from 28·7 to 30·0 and in lint per boll from 0·99 to 1·17. The values for progeny M.4620 are lowest for every character except lint length. The descendants of the family M.4208 show their usual characteristics of relatively high lint indices, and the seed weights of the descendants of the family M.4213 are relatively low.

Data for the Small Bulks Trial are given in the following table.

Family.	1945 Bulk.	1946 Bulk.	Ginning Outturn	Seed Weight per 100 seeds.	Lint Index.	Lint per acre.
			Per cent.	*gms.*	*gms.*	*lb.*
M.4208	MB.4507	MB.4608	33·50	13·13	6·58	473·5
	MB.4508	MB.4609	32·81	12·82	6·21	429·8
	MB.4508	MB.4610	32·76	13·03	6·34	450·3
M.4210	MB.4509	MB.4611	32·44	12·86	6·18	454·7
	MB.4512	MB.4613	31·93	12·70	5·96	432·3
	MB.4512	MB.4614	32·14	12·88	6·05	419·4
M.4213	MB.4515	MB.4617	32·48	12·88	6·05	473·5
	MB.4515	MB.4618	32·06	12·81	6·04	452·9
	MB.4516	MB.4619	32·44	12·50	6·01	449·5
	MB.4516	MB.4620	31·95	12·83	6·05	434·0
		Mean	32·45	12·84	6·15	447·0

In this trial statistical analysis revealed significant differences in every character: in lint yield differences were only detected between families, bulks MB.4613 and MB.4614 of the family M.4210 being the lowest yielders. Bulk MB.4613 also gave rise to several crinkled dwarfs this season. The yields of the bulks descended from M.4208 and M.4213 are equal, bulk MB.4608 descended from M.4208 being also equal to bulk MB.4617 descended from M.4213, both being the highest yielding bulks. The bulks descended from M.4208 have given relatively high ginning outturn, seed weights and lint index, bulk MB.4608 giving the highest value in every character.

Spinning Tests Results.

Hair and spinning test reports on last year's samples were received during the year. The Shirley Institute again reports small differences in strength of yarn in the progeny material, the differences between the extreme values of corrected count strength product being less than 10 per cent., and there was also little to choose between the yarns in appearance. The shortest of the samples according to the reports in both progeny row and small bulk material fell within the family M.4208, while the longest nearly all fell within the family M.4210.

Correlation coefficients calculated between ginning outturn, lint index and strength of yarn for both progeny row and small bulks trial revealed no significance. That between ginning outturn and standard hair weight for the progeny material was also non-significant, but was highly significant in the case of the small bulks trial.

Selection for 1947.

1947 Progenies will be selected mainly from the M.4213 family, i.e. from progenies M.4613—M.4620. The yields are relatively good, while their hair and spinning characters show little variation and are up to standard. In addition progenies M.4601 and M.4602 will be retained for further observation on account of high yield. The longest staple fell within the M.4210 family and two of its progenies—M.4611 and M.4612—will be retained.

Multiplication of Selected Seed.

The selfed seed from the selected progeny rows, after single plants were selected, was bulked to plant the four acres first multiplication area at the Grove. Yield was good in spite of the fact that weather conditions were not ideal. The seed from this area last year was used to plant some 200 acres at Richmond and 40 acres on the Government Land Settlement area at Parsons as second multiplication area. Supplies of seed from these areas as well as from the third multiplication areas are now stored in the Government Seed Store for the 1947 crop. Germination tests show the viability of this seed to be quite good.

Distribution of Seed to Neighbouring Islands.

The usual quantities of pedigree seed were supplied to Antigua, St. Kitts and Nevis for planting, and 20,000 lb. of third multiplication seed was also supplied to the Agricultural Department, Nevis, for planting. Small amounts of M.S.I. seed were also shipped to the Department of Agriculture in Seychelles and to India on request.

Experiments.

N.P.K. Trials on major soil series.

Some years ago cotton manurial trials were started in Montserrat with the object of finding out the soil requirements of the three main plant nutrients—nitrogen, potash and phosphate. Indications so far were that applications of nitrogenous manures gave big yield responses, though they may tend to cause bolting on Shoal soils—and applications of phosphatic manures gave some response particularly on Shoal soils. Potash applications gave little response. In the present series potash is omitted from the main comparisons, a basal dressing, however, being applied to each plot at the rate of 150 lb. sulphate of potash per acre. The object of the experiment is to investigate the effect of three levels of phosphate and nitrogen on four representative soils in the island.

The scheme consisted of one complete 3×3 randomised block experiment with four replications at each of the following places: Trants (Alluvial Soil), Richmond (Fresh Ash Soil), Waterworks (Shoal Soil), and Tuitts (Brown Earth Soil). One extra plot per block receives no potash and this by comparison with the ordinary control will enable a direct comparison to be made between potash and no potash independently of the main experiment.

Dry weather at and after planting, poor and irregular stands and other factors combined to render the results of the trials very inconclusive. Statistical analysis revealed real differences between treatments at one place—on Trants Alluvial Soil and in the case of nitrogen factor only. The deficiency of nitrogen in the soil was also

borne out by chemical analysis carried out on samples collected from the control plots and analysed by the Chemistry Department of the Imperial College of Tropical Agriculture. Professor Hardy reports that the percentage of nitrogen was very inadequate for cotton. The second level of application of nitrogen 200 lb. sulphate of ammonia per acre gave an increase in crop of 34 per cent., which would result in a profit of $13 to the acre to the planter after expenses on manuring have been deducted. In a previous experiment on this soil when rainfall was satisfactory 300 lb. per acre sulphate of ammonia gave an increase in crop of 60 per cent. The highest level of application of nitrogen, 400 lb. per acre, this season did not give an increase sufficient to compensate for the expenses on manuring. This and previous experiments as well as laboratory analysis indicate the phosphate and potash status of this soil to be adequate.

Planting Date Experiment.

Preliminary trials with sodium selenate have been started to ascertain the rate and effectiveness of applications of sodium selenate in controlling pests without adversely affecting the plant, and then to use the method to compare the cropping potential of cotton planted at different seasons. The plots have been well protected by wire fencing to guard against the possibility of danger to animals.

PROGRAMME OF EXPERIMENTS FOR 1947.

Breeding. The breeding and seed multiplication programme will be continued on the lines of the past year.

Field Experiments.

(1) The N.P.K. trials on the major soil series will be continued.

(2) Trial of pen manure.

(3) A simple rotational trial will be started to compare continuous cotton growing with a rotation including green manuring and one with a resting period in grass.

[*Included by courtesy of the Government of the Windward Islands.*]

PROGRESS REPORT

ON THE

COTTON BREEDING WORK

AT

CAMDEN PARK EXPERIMENT STATION, ST. VINCENT, FOR THE SEASON 1945-46.

BY

W. R. E. NANTON.

General Information.

	Island Crop.	*Experiments.*
Sowing Dates	16th August—15th October	22nd September.
Picking Dates	December—January—February ...	—
Legal Close Season	1st May—15th August	—

Weather Conditions.

The year was a remarkably dry one with no well-defined wet season. The crop was planted late in the season and rainfall during the first few weeks favoured satisfactory growth. A three-week dry spell at the end of November and the first half of December severely checked growth and boll development, which, however, were resumed with the welcome showers towards the end of the year. Ripening conditions were ideal, light showers favouring the development of late bolls and a very fair crop was finally picked.

Breeding Programme.

Pending a decision by the Cotton Adviser, the programme for 1945–46 was drawn up on almost exactly similar lines to that of the previous year and comprised the three main items, viz. :—

(*a*) The V.135 (V.46) seed renewal scheme.
(*b*) The VH Hybrid breeding trial.
(*c*) Variable bulks and type collection.

*V.*135 *Seed Renewal Scheme.*

Sixteen plants, selected from the 1944–45 material and representative of six progenies, were carried on as progeny rows in the 1945–46 season. As is usual, they were grown non-replicated and self-fertilised.

No off-type plant was observed in the 1944–45 progeny rows, consequently all selfed seed remaining after selections had been made for progeny rows was bulked for multiplication. The first multiplication plot yielded 1,820 lb. for further multiplication.

The 1,562 lb. of seed obtained from the first multiplication plot in the 1944–45 season was sown partly at Brighton Estate and partly at Camden Park. The yield of seed for planting amounted to a total of 31,776 lb. from the two sources, and in addition 11,695 lb. were reserved from Diamond Estate as an additional safeguard against a shortage.

VH Breeding Trial.

The 1945–46 VH breeding trial was very similar to that of 1944–45, nine progenies each of the two main genotypes VH.8 and VH.10 being included; four other VH crosses, with B.S.I., M.S.I. and V.135 included for comparison. The experimental layout consisted of three 5×5 lattice squares, with a plot size of $8' \times 8'$ made up of two 4′ ridges each accommodating four plants spaced 2′ apart on the ridge.

Weather conditions at planting time were favourable and very little supplying sufficed to give an excellent stand. A sample plant was marked at flowering time in each plot and picked separately, the number of bolls thus picked being recorded at each picking. The seed cotton from these sample plants served as samples for the estimation of seed cotton per boll, which character was used in the estimation of bolling per plot. All other characters were calculated direct from the bulk of the cotton picked from each plot. A summary of these data is given in Table I.

TABLE I.

Summary of Main Results. V.H. Breeding Trial.

Strain..	*Lint per Plot.*	*Ginning Outturn.*	*Seed Weight.*	*Lint Index.*	*Bolling Index arbitrary.*	*Seeds per Boll.*	*Strength.*
	gm.	%	*gm.*	*gm.*			
Mean of 9 VH.8 Progenies	326	28·9	14·4	5·8	327·7	17·2	2872
Mean of 9 VH.10 Progenies	356	33·3	14·9	7·4	262·9	18·2	2427
B.S.I.	357	28·4	13·4	5·3	435·7	15·5	2984
M.S.I.	257	32·8	14·5	7·1	173·0	20·7	2492
V.135	281	25·8	14·2	4·9	323·0	17·7	3179

The sum of squares for progenies was analysed further to demonstrate the separate contributions of strains, families, and progenies within families. This analysis showed, as might have been expected, that differences between strains were large and significant. Differences between families belonging to the same genotype and differences between sisters in the same family were of doubtful significance.

Small-scale spinning tests were carried out on samples of all progenies through the courtesy of the British Cotton Industry Research Association. Mean figures for the Count × Strength product corrected

for count difference are given in last column of Table I under the heading " Strength." The tests showed that while all the VH.8 progenies were within the range for superfine quality, no one equalled V.135 for strength. There were, however, two outstanding progenies, viz., VH.4502 and VH.4509. The " Strength " figures for these two types were 3008 and 3037 respectively. The tests confirmed that the VH.10 genotype was of only " ordinary " quality.

In the light of past season's records, substantiated by results of the year under report and by recent spinning tests, it was decided to discontinue selection work on all except the VH.8 material. Representatives of all the VH.8 progenies were therefore carried forward to the 1946–47 trials, the remaining lots of breeding material being continued only as variable bulks.

Variable Bulks and Type Collection.

The collection of variable bulks of cotton strains of possible future importance was maintained, and with it was combined the collection of typical Sea Island strains. Future work on the type collection is to be carried out at the Cotton Experiment Station, Antigua, Leeward Islands.

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" The Extension of Cotton Cultivation in Tanganyika Territory." Major Hastings Horne. 1922. Price **2s.**

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